TECHNOLOGY DEPT.

PUBLIC LIBRARY
FEB 26 1940
DETROIT

AMERICAN MACHINIST

February 21, 1940

Time Saving—*Total time for turret lathe jobs can be minimized by balancing times for setting up, handling work and machine, and actual cutting*

MASON BRITTON, Vice-Chairman
FRED H. COLVIN, Editor Emeritus
BURHAM FINNEY, Editor
KENNETH H. CONDIT, Consulting Editor
JOHN HAYDOCK, Managing Editor

S. ASHTON HAND — BEN C. BROSHEER
WILLIAM W. HORINE — WILLIAM J. HARGEST
FRANK RISING — C. G. SMITH
RUPERT LE GRAND, Detroit — RAYMOND R. WIESE, Chicago
PAUL WOOTON, Washington — CHAS. F. McREYNOLDS, Los Angeles

N. O. WYNKOOP, Publisher
W. E. KENNEDY, Manager

McGraw-Hill Publishing Company, Inc.

Publication office, 99-129 North Broadway, Albany, N. Y. Editorial and executive offices, 330 West 42nd Street, New York, N. Y. Branch offices: Chicago, 520 North Michigan Ave.; San Francisco, 68 Post Street; Aldwych House, Aldwych, London, W. C. 2; Washington; Philadelphia; Cleveland; Detroit; St. Louis; Boston; Atlanta.

JAMES H. McGRAW
Founder and Honorary Chairman

JAMES H. McGRAW, Jr., President — HOWARD EHRLICH, Executive Vice-President
MASON BRITTON, Vice-Chairman — B. R. PUTNAM, Treasurer
D. C. McGRAW, Secretary — J. E. BLACKBURN, Jr., Director of Circulation

VOLUME 84 NUMBER 4

AMERICAN MACHINIST. Copyright 1940 by McGraw-Hill Publishing Co., Inc. Published every other Wednesday, price 35c a copy. Subscription rates—United States, Canada, Mexico, and Central and South American countries, $3.00 a year. All other countries (except Europe and British possessions in Eastern Hemisphere), $6.00 a year or 36 shillings. Entered as second class matter, September 29, 1936, at Post Office, Albany, N. Y., under the act of March 3, 1879. Printed in U.S.A. Cable address: "McGrawhill, New York." Member of A.B.P. Member of A.B.C.

A McGRAW-HILL PUBLICATION

PRINTED IN U.S.A.

MAJOR ARTICLES

Time and Tools.....*J. R. Longstreet and W. K. Bailey* 79
Hardened by Induction..... 82
Spherical Seat Assured.....*J. H. Yeager* 84
Men Trained in Four Weeks..... 85
Balance Becomes Electric..... 87
A Job Shop for Miniature Parts.....*Pierre Dumaine* 88
The Working of High-Speed Steels..... 93

IDEAS FROM PRACTICAL MEN

This Cutter Chamfers Inside Holes.....*George C. Lawrence* 90
A Fixture That Aids in Milling Keys.....*R. H. Patterson* 90
Locating the High Spot on Round Work.*Robert S. Alexander* 90
Machining Spherical Surfaces.....*Stanley Porritt* 91
Square Shear Has Conveyor and Stop.....*Joseph I. Karash* 91
Truing Chucked Work.....*R. B. Ware* 92
Special Bolts Threaded on Turret.....*A. A. Leonhardi* 92

SHORT ARTICLES

Lining Up Locomotives..... 86
Copper-Base Alloys Tested for Die-Casting..... 119
The Best Toolmaker.....*Charles Weslow* 120

NEWS OF THE INDUSTRY

Gaging Business 104b
Inside Detroit 104e
Watching Washington. 104h
Business Items 104j
Personals 104k
Obituaries 104l

DEPARTMENTS

What's in This Issue.. 45
Reference Book Sheet.. 101
Editorial 104a
Shop Equipment News. 105
Trade Publications 116
New Books 118

ADVERTISING PAGES REMOVED

THE JOHN BERTRAM & SONS CO. LIMITED

MACHINE TOOLS

DUNDAS, CANADA

HEAD OFFICE & WORKS

BERTRAM

Mr. T. J. McCarron,
American Machinist,
330 West 42nd Street,
New York, N.Y.

Dear Mr. McCarron:

This will acknowledge your letter of the 17th, and I wish to thank you for the stickers for the front of the Machinist to guide it on its way through the shop.

It would almost seem as though my first mechanical book was the American Machinist, and in the early days when it was quite a large-sized sheet they used to be bound, and I believe in the basement we have them dating back to the early 80's. It is rather interesting to look over the old designs and compare them with the machines turned out at present.

Yours very truly,

H.G. Bertram

H.G.Bertram,
-AGD-

"It would almost seem as though my first mechanical book was the ... AMERICAN MACHINIST"

WHAT'S IN THIS ISSUE

REMOTE CONTROL

You won't be able so much as to flip through this number of AMERICAN MACHINIST without noticing the special section on high-speed steels—at least we hope not. As promised, this section contains information gleaned from steel makers, steel users, tooling experts and practical shop men. It's one of those things that seem impossible to put together when you start it, impossible to finish once you get going, and impossible to squeeze into the allotted space when the compilation's complete. It's been done, though, and printed on our favorite blue paper, beginning on page 93. When you're using it you might pause and give a silent prayer of thanks to one Mr. Rupert Le Grand, our Detroit Editor, who put the dope together and got it into print by remote control via New York and Albany. He writes us it's wonderful to enjoy again the luxury of sleep.

SERIAL

Also in this issue is the first article in a swell series on turret lathe tooling. This series has been planned and written with the idea of helping every single owner of a turret lathe, whether he might have one or fifty.

W. K. BAILEY

J. R. Longstreet and W. K. Bailey, of Warner & Swasey, are the authors. What they've actually written is an entire book on the subject, which will be published as soon as the various chapters have been run in AMERICAN MACHINIST. The first is on page 79. We feel that in these times especially the information in the series is of rare value. We think you'll be as enthusiastic about it as we are, too, after you've read the first installment.

INGENIOUS

Last fortnight we pointed out how little changes in design can raise cain with manufacturing operations. The example was a bearing in Buick independent suspension linkages, a mass-production problem if ever there was one. In this number we present another example of what happens when product design is altered, only this time it's a straightforward machining set-up with rather limited quantity. It's one of the best cases we've found where a little ingenuity solved about six shop problems at once. J. H. Yeager tells all about it on page 84.

HARDER EASIER

Induction hardening has emerged from the laboratory stage and is now being used advantageously by Chevrolet, among others, to harden parts previously left soft. Special machines make it a comparatively easy job, once the bugs have been ironed out and everything is running smoothly. "Hardened by Induction," on page 82, tells how the process works out under actual shop conditions.

MICROSCOPIC

Ever since we were old enough to know what precision meant, tiny parts for accurate instruments have always fascinated us. Even now we can't pass a watchmaker's window in less than ten minutes if the craftsman's doing anything on his little lathe. So when we got a chance to find out how Waltham makes a lot of special little precision parts we jumped at it. Their work is intricate, interesting and instructive. On page 88 you'll find the details of several problems they've solved in turning out thousands of miniature precision parts. Pierre Dumaine, head of the Custom Parts Division, tells about it.

J. R. LONGSTREET

PIERRE DUMAINE

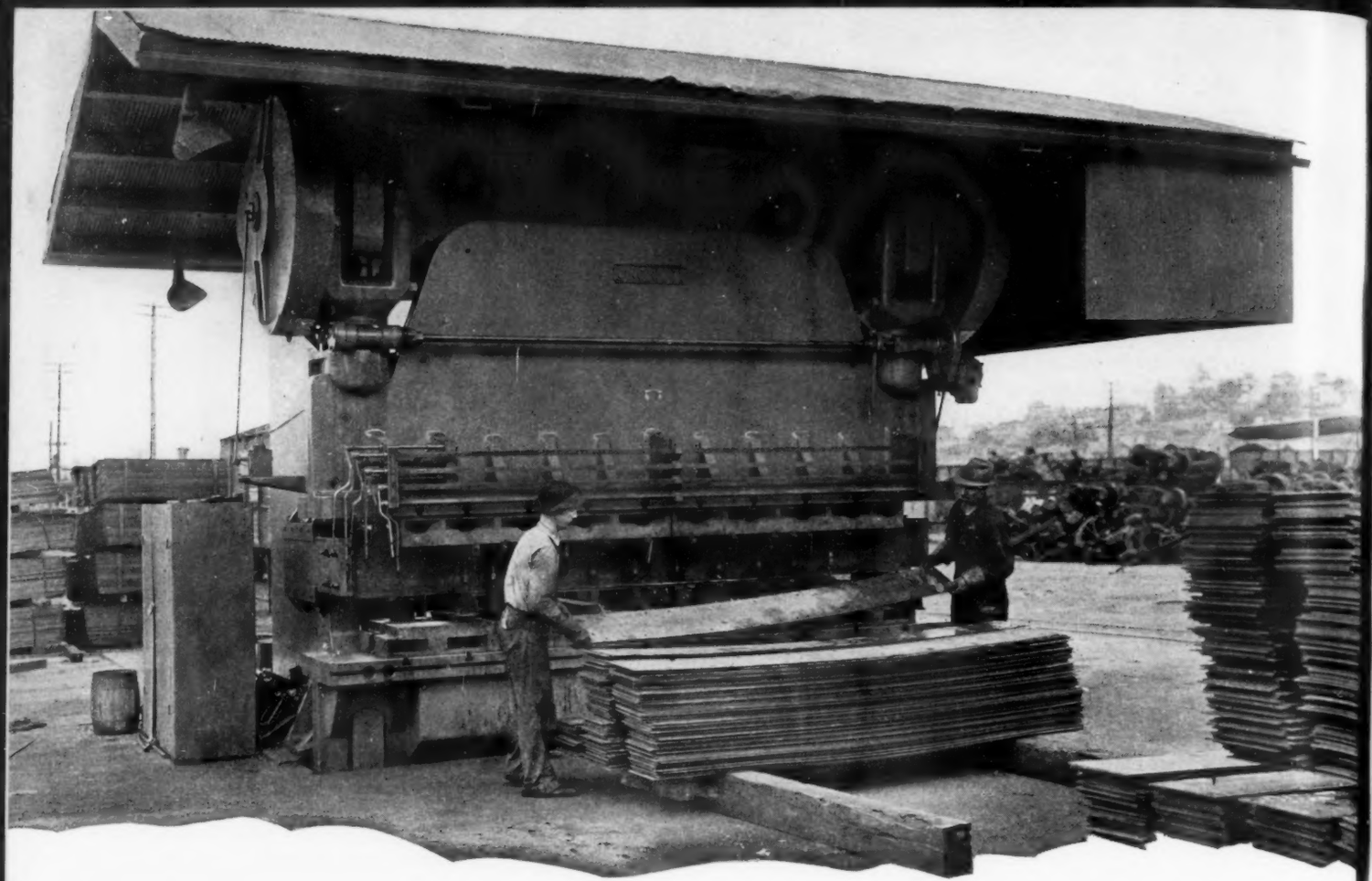
BETTER BALANCE

Internal combustion engine crankshafts have long been made principally on semi-automatic equipment. But balancing them has, until recently, been a tedious task requiring highly skilled labor. There's no reason of course, why an unbalance-measuring machine couldn't be hooked up to a drilling machine in some way so that the whole process would be automatic. But things like that just don't ever seem to get done—until somebody does them. This time it's International Harvester. The hows and whys are on page 87.

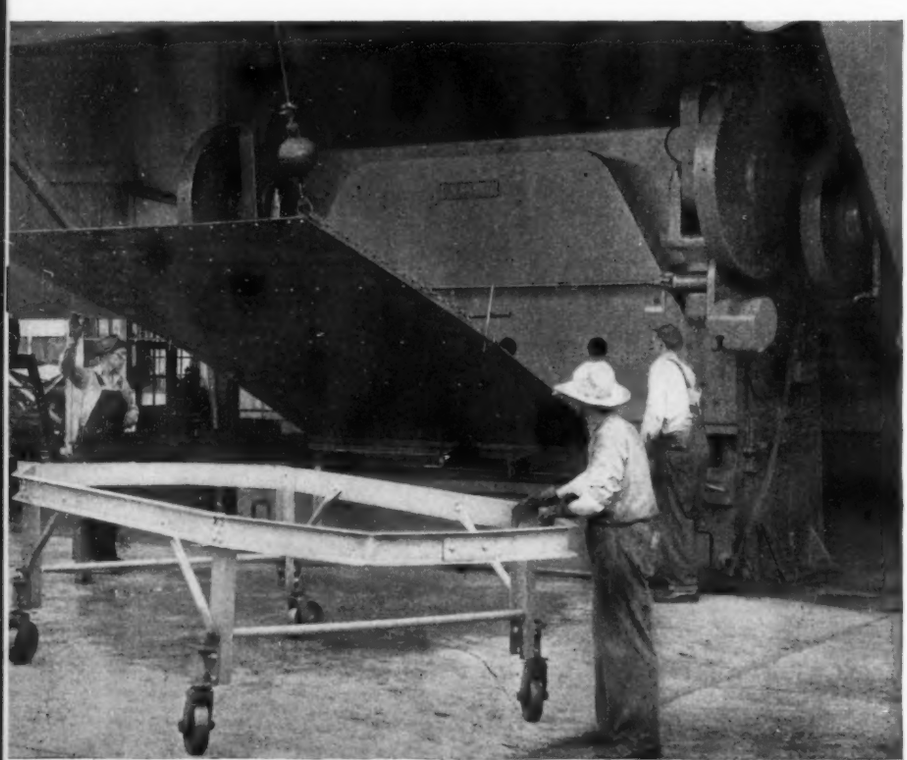
COMING

You've probably heard a lot about stainless steel aircraft. And you may already know there's quite a controversy in aircraft circles over stainless, some being convinced of its worth and others maintaining aluminum's the only thing. Just what is being done with stainless steel in aircraft will be discussed in an early story on Fleetwings, who've done more with it than you might think.

Developing second sight in foremen may sound like just so much black magic, but behind the wordage hides many a good idea. You can expect a searching article explaining it soon in AMERICAN MACHINIST.



Paid For Itself In Four Months



ON one job alone, required for the rebuilding of 1800 hopper cars, the above recently installed 400 series Cincinnati All-Steel Press Brake completely refunded the investment in four months.

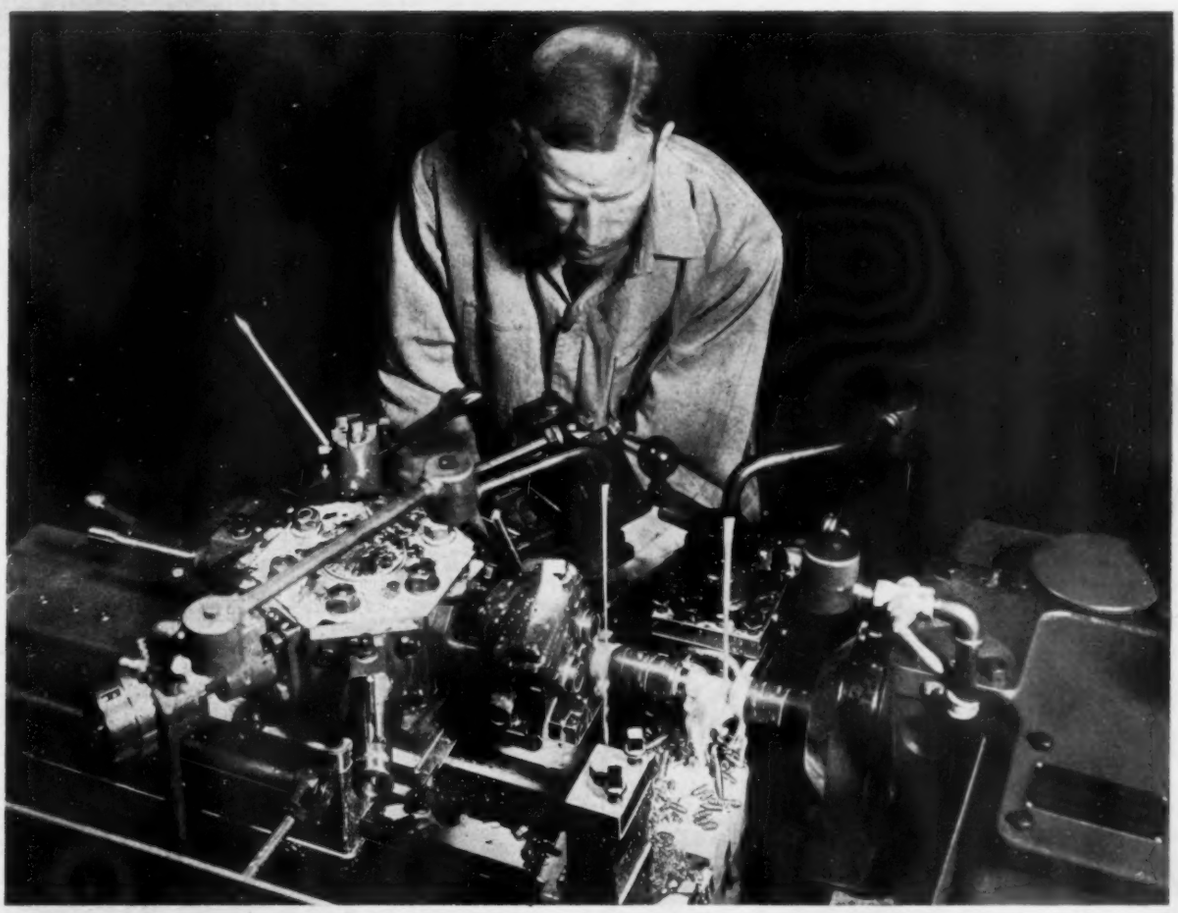
● ● ● ● ●

At the left is another CINCINNATI PRESS BRAKE working for a railroad. Job illustrated—bending end on hopper chute. Records show that this unit has refunded the investment at least four times during its 3 years of service.

Every plan for modernization or new car construction should include the economies which can be effected with Cincinnati All-Steel Press Brakes.

Write for recommendations on your job.

THE CINCINNATI SHAPER COMPANY, CINCINNATI, OHIO



TURRET LATHE TOOLING—No. 1

Time and Tools

BY **J. R. LONGSTREET** AND **W. K. BAILEY,** THE WARNER & SWASEY COMPANY

Tools that cut cutting time are fine, if operating principles are kept constantly in mind

TWO THINGS MARK a good turret lathe operator. He runs his machine at the correct speed and feed; he knows how to grind and set cutters for a given job.

Sounds simple, but a lot of know-how falls under these headings; and the man who masters them is in demand wherever turret lathes are used. This article and those that follow tell the principles underlying turret lathe tooling and how they can be applied in practice.

The fundamental aim on every turret lathe job is to tool up the machine and operate it so the job can be turned out in as short a time as possible, provided that the savings resulting from special equipment or complicated set-ups justify their cost.

Total production time for any job is made up of four elements: (1) *set-up time*—to set and adjust all tools and cutters, and to arrange holding devices; (2) *work-handling time*—to load and unload the work into and out of the machine; (3) *machine-handling time*—to start and stop each cut, index and move the turrets, slides and attachments, and to change the speeds and feeds; and (4) *actual*

From a forthcoming book on turret lathe operation.

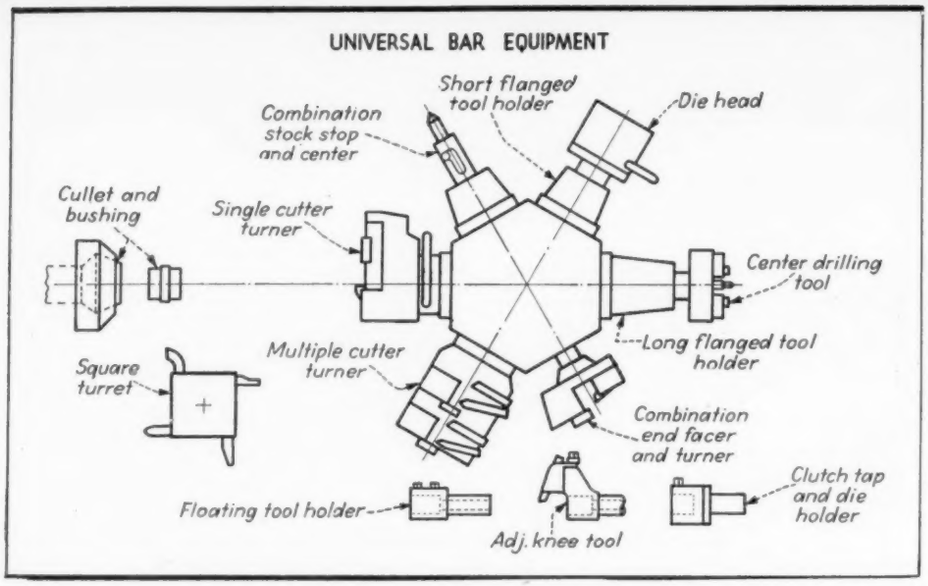


Fig. 1—Universal tooling equipment for a permanent set-up for bar work includes such standard tools as single and multiple cutter turners, a combination facer and turner, die and tap holders, and collets. These are quickly adjustable for a variety of work

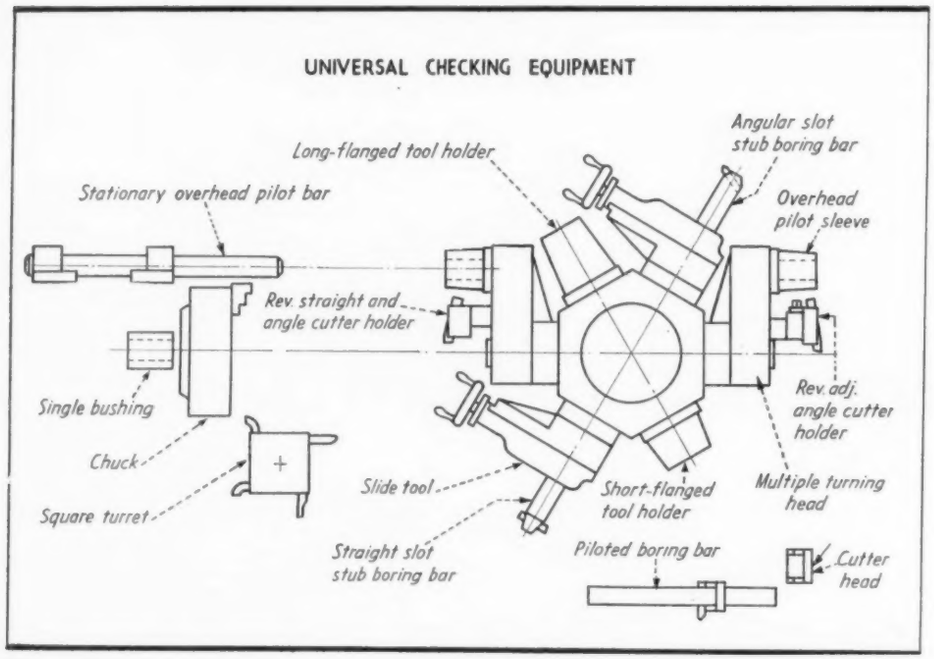


Fig. 2—Pilot bars, slide tools, various boring bars and cutter holders, as well as standard flanged tool holders, make up the permanent set-up of turret lathe tools for chucking work

cutting time—actually to remove the metal.

Since the whole purpose of the job is to remove metal, it might seem at first that the cutting time is the important consideration. However, set-up time, work-handling time and machine-handling time may be just as important as the actual cutting time. It is the sum total of all four elements which makes up total production time; basically, we are interested only in the total time required to complete a given number of parts.

In the average shop, producing small quantity work, the best method of reducing set-up time is to use universal tooling equipment and to keep a "permanent set-up" of tools on the machine. The turret lathe should be equipped with standard tools which will handle a large variety of work and which are quickly adjustable. Experience has developed two sets of universal tooling equipment, one for bar work (Fig. 1) and one for chucking work (Fig. 2).

A permanent set-up of universal tooling equipment can be arranged so that the large and heavy tools of the flanged type are permanently mounted in their logical order on the machine. If necessary for certain jobs, the tool stations can be back-indexed, or skip indexed, to suit the requirements of the job, but the flanged tools themselves are not changed from one turret face to the other. Ordinarily the extra machine-handling time required to skip-index is less than the time that would be required to remove

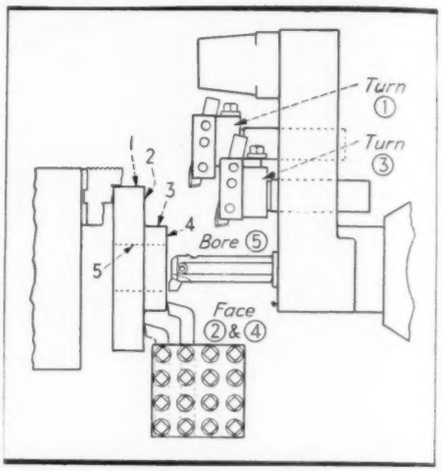


Fig. 3—This set-up for a simple gear blank involves the use of both multiple and combined cuts

these tools from the machine, or to change their position on the turret.

Lighter tools in the universal set can be arranged in various combinations to adapt the tools in the permanent set-up to each particular job as it comes along. These lighter tools are of the shank type and can be mounted quickly in the turret or holder. The adjustable features of the tools in the universal tool set-up will allow the setting of cutters quickly to accurate size and permit changing quickly from one job to another. Having the larger tools arranged in a permanent set-up does away with the constant changing of these tools for each job.

Reduction of work-handling time depends chiefly on the selection o chucks and fixtures to hold the work. For the average shop, producing small and medium quantity work, the best equipment is usually of standard design to which special jaws, arbors and simple fixtures can be added. Naturally, savings on quantity production sometimes will justify special fixtures designed for a specific job.

To reduce machine-handling time, multiple cuts can be taken, thereby reducing the number of turret indexes. In other words, place as many cutters in one tool station as is prac-

tical. Tools in the universal tooling equipment provide holders for taking these multiple cuts. It also is important to select the proper size of machine for the job. Ordinarily, the larger the machine, the more time is required to change from one tool to the next.

Frequently, the element of cutting time offers the greatest possibilities of reducing the total production time.

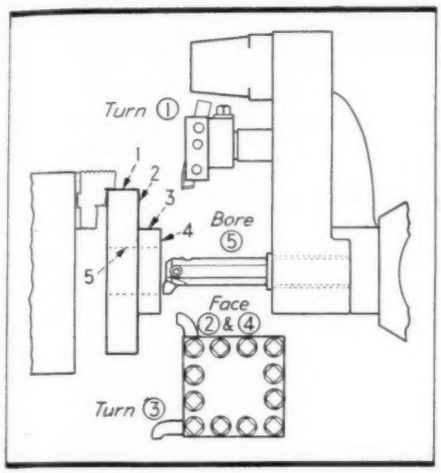


Fig. 4—Where the number of pieces is small, the job shown in Fig. 3 probably would be tooled more simply

There are many factors that affect cutting time, but when planning a set-up on a job, the following four factors are most important and should be considered before the set-up actually is made.

MULTIPLE CUTS—Hexagon Turret. Which cuts should be taken from the hexagon turret and, which cuts can be combined in one tool station?

MULTIPLE CUTS—Cross Slide. Which cut should be taken from the cross slide and, can more than one cut be taken at the same time?

COMBINED CUTS. Which cuts to be taken from the cross slide can be combined with cuts taken from the hexagon turret?

RIGID TOOLING. Which speeds and feeds can be used?

Combined and Multiple Cuts

The terms "combined" and "multiple" should be thoroughly understood. A simple example of combined cuts is where a cut taken with a roller turner on the hexagon turret is combined with a turning cut taken with a cutter held in the square turret. When we refer to combined cuts we refer to the operation of both the hexagon turret and the cross slide at the same time.

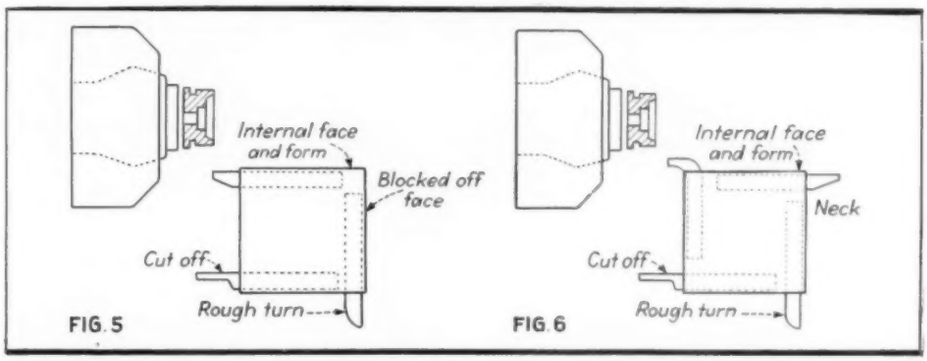
Fig. 3 shows how the tooling set-up for a simple gear blank can be planned. The longest cut from the hexagon turret is obviously the boring cut, (5). The principle of multiple cuts is illustrated by placing the cutter holders for turning diameters (1) and (3) in the same holder as the boring bar. On the cross slide, multiple cuts can be taken with two cutters placed in the open-type square turret facing surfaces (2) and (4). The tool arrangement is such that all of these cuts can be combined so that they are done at the same time.

If only a small number of pieces are to be made, it may be practical to set up the job as shown in Fig. 4. Turning cut (1) and boring cut (5) are taken from the same tool station and turning cut (2) and facing cuts (3) and (4) are taken from the square turret; but cuts (2), (3) and (4) are not taken at the same time. However, cuts (2), (3) and (4) are combined with cuts (1) and (5).

The ability to take multiple cuts will depend largely upon the rigidity of the machine and the tool holders. Also, the feeds that can be used will depend upon the rigidity of the machine and tools. In order to gain full advantage of combined and multiple cuts, they must be taken at about the same feed and speed that would be used when these cuts are taken individually. Care should be taken to provide the proper tool holder so that the machine can be run under the heaviest feeds possible.

The rigidity of the set-up can be increased in three ways: by the use of rigid tool holders designed to allow the combining of cross slide and hexagon turret cuts, and the taking of heavy cuts; by keeping the overhang of the tools to a minimum; and by the use of pilots.

The use of overhead and center pilot bars increases the rigidity of the tools and the machines on chucking work. Most bar tools are, in themselves, rigid because they are designed in such a way that the cutting forces are self-contained, and are absorbed by the tool itself. However, in the case of chucking tools which work on large diameters, it is not possible to do this, with the result that twisting and straining forces need to be offset by the use of pilot bars which definitely connect the hexagon turret with the head tying the two together.



Figs. 5 and 6—Stations on a square turret should not be blocked off, as in Fig. 5, but should be set up as in Fig. 6 so as to permit the use of a fourth tool

Pilot bars can be either external (commonly called overhead pilot bars) or internal (commonly called center pilot bars). The use of overhead piloting on a typical gear blank job is illustrated in Fig. 4. The pilot bar not only allows a heavier feed to be used, but also permits greater accuracy.

It should be kept in mind that the overhead pilot bar is in a position to absorb both lifting and twisting strains, such as result from the overhead turning cutters, and that the center pilot bar is in a position to overcome lifting strains only.

What Not to Do

In connection with general tooling principles, here are three important "don'ts":

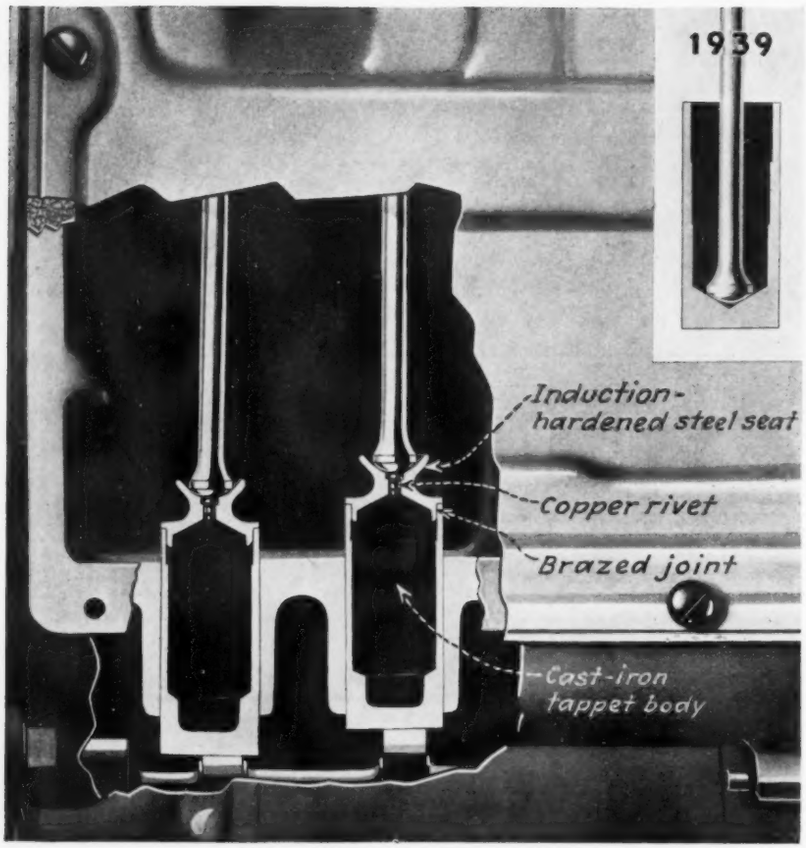
1. Don't block off stations on the square turret (see Figs. 5 and 6).

2. Don't clamp the saddle of a ram-type machine in such a position that all of the stations cannot be indexed. When setting the saddle on the bed, the longest tool on the turret will usually govern the position of the saddle.

3. Don't take any tooling set-up for granted. Almost every job can be done in several different ways. Study the work and see how the set-up can be improved.

Hardened by induction

Chevrolet adapts a well-known electrical phenomenon to mass-production methods for hardening valve mechanism parts previously left soft. Better design is one of the incidental advantages gained by the process

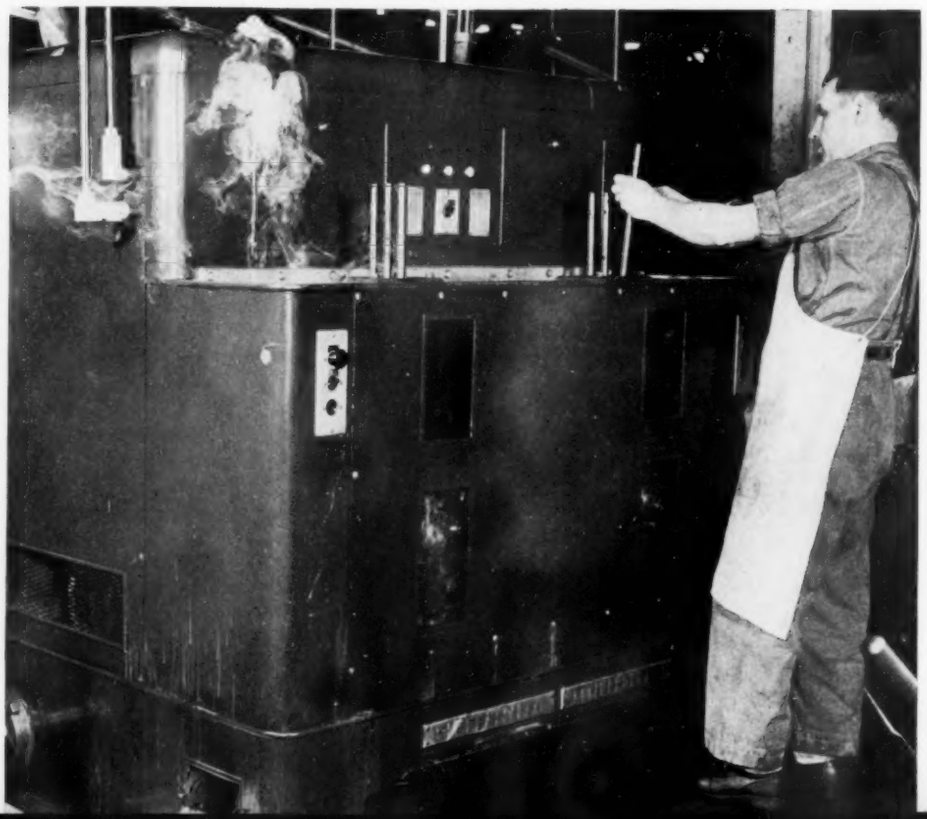


Adoption of a steel "flower pot" brazed to the top of the tappet permits Chevrolet to harden the push-rod seat by induction

INDUCTION HARDENING—an accurately controlled process of electromagnetically heating selected portions of steel pieces and quenching with water jets—has made possible the hardening of two Chevrolet valve-mechanism parts formerly left soft because of manufacturing difficulties.

The two parts in question are the push-rod seat of the valve tappet and the bearing surfaces of the rocker arm shaft. There are twelve tappets and two shafts per engine, each shaft having six hardened bearing areas. Thus 24 surfaces per engine are now made wear-resistant by induction hardening.

In the 1939 tappet, the solid cast-iron slug was drilled out and the bottom of the hole machined to provide the push-rod seat, which was impractical to harden. Furthermore, to pre-



Three valve rocker arm shafts are dropped into openings at the left of this machine, which hardens three bearing surfaces on all while they are at the first level. They then drop to a second level, where three more surfaces are likewise hardened. Meanwhile the operator loads three other shafts into the right-hand side of the machine

vent trouble in drilling, the depth of chill had to be closely controlled in the foundry. Had the chill included the seat, the latter would have to have been ground, which was not feasible.

Therefore the 1940 tappet was redesigned to include a steel push-rod seat, or "flower pot," machined from bar stock and brazed to the open end of the cast-iron tappet. Its use permits a cored casting to be used for the tappet, results in a shorter push rod, and provides a hardened surface which reduces wear. The steel seat is the part of the tappet hardened by the induction method, the process being controlled so that the heat does not scale the seat nor affect the brazed joint or tappet body. Its advantages could not have been secured economically otherwise.

Production of the tappet assembly begins with the tappet bodies being rough ground on the outside diameter, end faced, drilled to depth, and washed. The steel seat, produced on an automatic screw machine, is washed, dipped in copper sulphate to acquire a thin copper coating, and then dipped in borax solution, which serves as a brazing flux. A brass brazing ring is fitted to the steel seat and it in turn assembled to the tappet body. This assembly is then loaded into a conveyor-type brazing furnace having a rich atmosphere to prevent scaling. The chilled end of the tappet rests on a conveyor-chain block which passes through water-cooled guides to prevent drawing the chill.

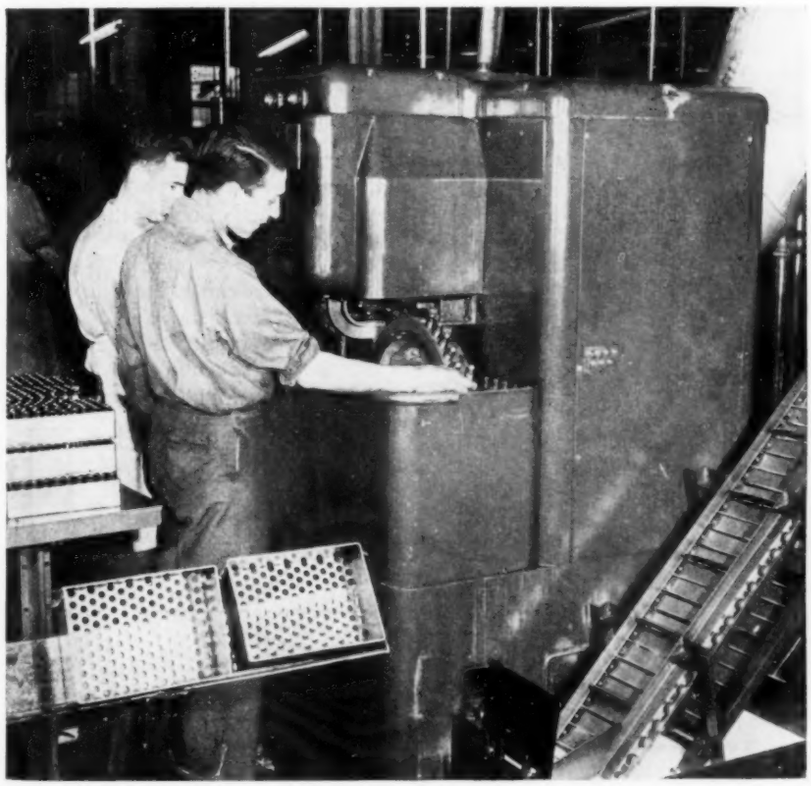
Machining the spherical push-rod seat in the tappet is done after brazing so that it will be at right angles to the tappet-body axis. Cutting oil is removed from the part, particularly the inside, by whirling it, seat-end out, in a centrifugal drier. This step is made necessary by a small hole through the bottom of the seat. This hole is provided to permit escape of air expanded in brazing, which would otherwise lift the seat before the braze set properly. The hole also provides an oil relief below the seat during operation in the car.

Entire Cycle Automatic

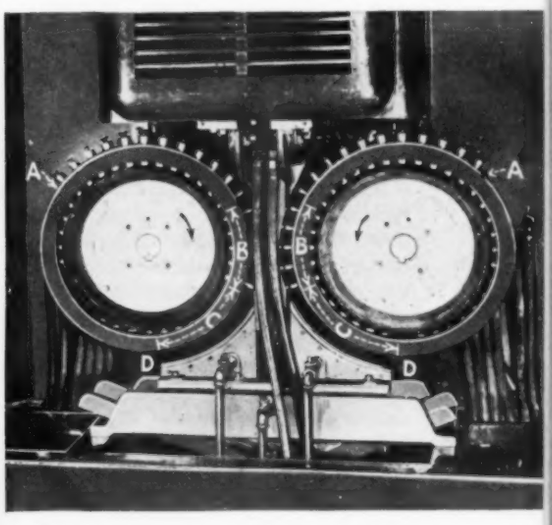
Length of the brazed assembly is gaged before induction hardening, which is done on a machine served by two operators. Assemblies are loaded into inward-turning circular carriers, between which is located the water-cooled inductor block. As each tappet body reaches a point about 45 deg. past the vertical center line of its carrier, it comes under the influence of the electrical field and is heated by induction to 1,500 F. Heating lasts for three or four seconds. When about level with the carrier center line, the tappet passes out of the field and immediately enters a water-spray zone. When it reaches the bottom it falls through a chute into a sump filled with a rust-inhibiting compound. It is then finish ground, dried in an oven, and the bottom of the oil-relief hole plugged with a copper rivet. Production per hour per carrier is 2,700 pieces, or 5,400 for the machine.

Valve rocker arm shafts are hardened on six surfaces in another machine. The operator loads three shafts into one end of the machine, and while these are being hardened drops three more into the other end. The shafts are hardened in two stages. At the first level three surfaces on each shaft about an inch long are heated by induction coils and quenched by water jets, after which the shafts drop to a second level where the process is repeated. They are then released and fall into a soluble-oil sump.

Machines and electrical equipment are not expensive, considering the mass-production output attained. Cost of operation is low, in the case of the tappets being only a few cents per hundred for power and labor. The electrical system is special only in that 3,000-cycle current is supplied to achieve the proper rate of heating.



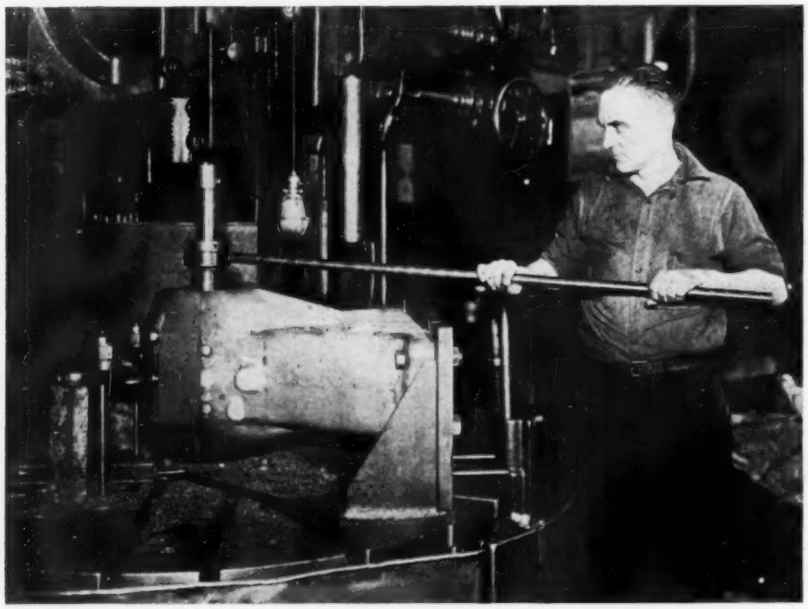
Operators load brazed tappet assemblies into two dials built into an induction hardening machine. A master panel at the back controls current, voltage, and speed of tappets through the magnetic field



Tappets are loaded at A, *inductively heated in zone* B, *quenched in zone* C, *and released at* D

Spherical seats assured

BY **J. H. YEAGER,** METHODS DEPARTMENT, RELIANCE ELECTRIC & ENGINEERING COMPANY



Turning a tubular face cam through 180 degrees makes the toolholder pivoted in the boring bar generate an accurate spherical seat in this bearing pedestal. Seat is twice as large as the bar hole

Machining the spherical seat to a tolerance of +0.001 —0.000 in. is made easy by this pivoted boring bar. A ground button on the back end of the toolholder enables the toolbit to be set with a micrometer

IN DEVELOPING a series of pedestals for use on large motor-generator sets, Reliance Electric & Manufacturing Company ran into a tough problem in machining spherical seats. The tolerance was +0.001–0.000 in., the boring tool had to be entered and positioned through a cavity only half the diameter of the seat, and the boring operation itself had to be completed blind.

Thus the setting of the boring tool had to be predetermined both as to center line and cutting radius. The size of the casting and the nature of the machine tools available further dictated that the job had to be done on a 63-in. vertical boring mill.

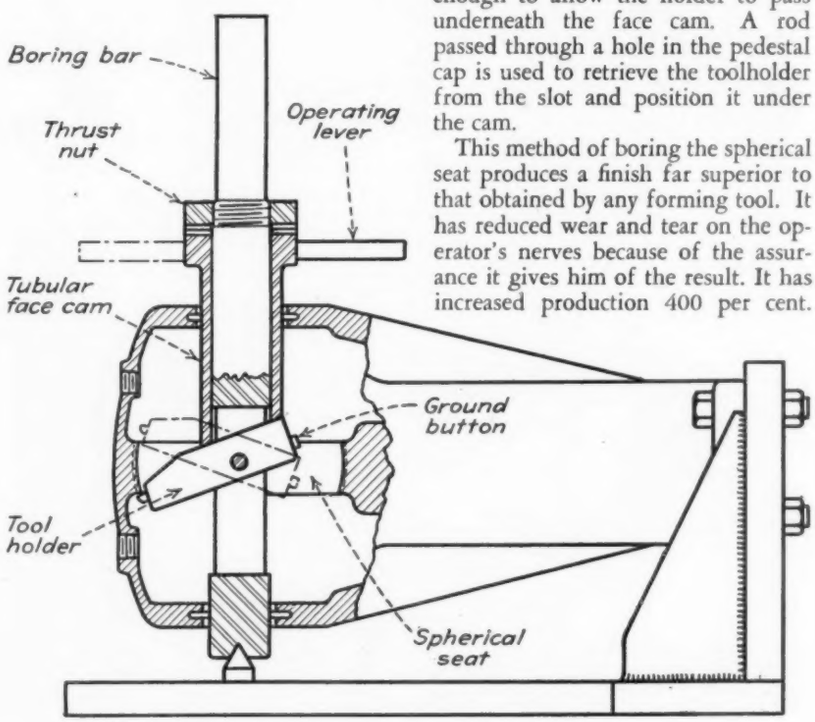
The problem was solved satisfactorily by constructing a boring bar with a rocking toolholder. This toolholder is carried in a slot through the body of the boring bar and is actuated by a face cam formed by the end of a tube fitting over the bar. The face of this cam is held snugly against the toolholder by a nut, thrust washers between the tube and nut permitting rotation of the tube around the bar.

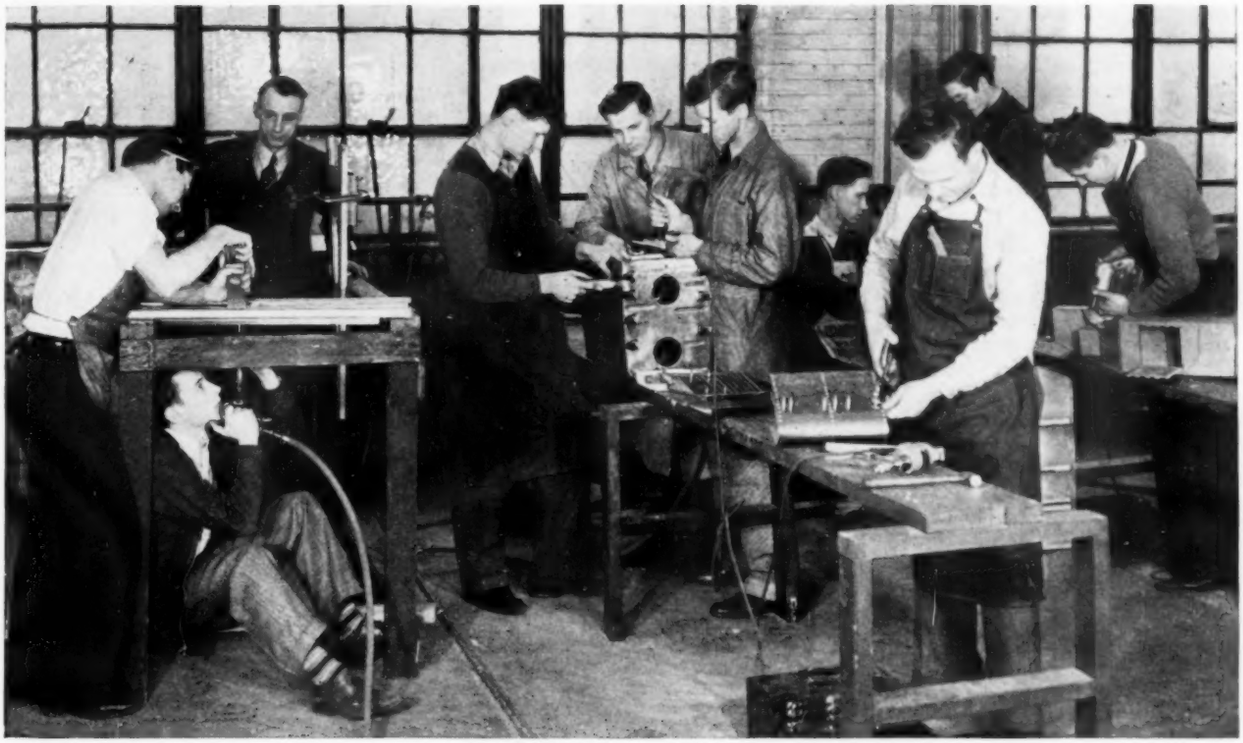
In the set-up finally evolved, the pedestal casting is bolted to an angle plate secured to the boring mill table. In the base of the angle plate is a center point which stabilizes the boring bar and determines the position (elevation) of the tool. When the tube is rotated through 180 degrees, the face cam rocks the toolholder through its entire range.

To secure the utmost accuracy, the cutting point of the toolbit must be held dead on center with relation to the center of the bar, as well as on the center of the shaft carrying the toolholder. A button on the back end of the toolholder, ground to a known dimension from the center of the rocker shaft, furnishes a point from which the toolbit can be set accurately with a micrometer.

The slot in which the toolholder operates is long enough, and the toolholder itself is narrow enough, so that it can be nested entirely within the bar while the latter is lowered through the small opening in the end of the casting. To nest the toolholder it is necessary to back off the thrust nut and lift the operating tube enough to allow the holder to pass underneath the face cam. A rod passed through a hole in the pedestal cap is used to retrieve the toolholder from the slot and position it under the cam.

This method of boring the spherical seat produces a finish far superior to that obtained by any forming tool. It has reduced wear and tear on the operator's nerves because of the assurance it gives him of the result. It has increased production 400 per cent.





Class being given final instruction in sub-assembly of rivet sections

Men trained in four weeks

Curtiss finds it is safer to teach youth precision aircraft methods than to "untrain" men who have learned their trade in less exacting industries

"YOU CAN'T walk back from an airplane ride." Such is the terse comment of Charles S. ("Red") Mattoon, one of the aviation industry's outstanding personnel men. Mr. Mattoon was speaking for the Curtiss Aeroplane Division of Curtiss-Wright Corporation at Buffalo.

Because you can't walk back, airplanes must be built with double care. Precision to an unusual degree is necessary. Hardly in any other industry is such perfection in workmanship essential. For that reason alone, there are scarcely any labor reservoirs upon which to draw. New reservoirs have had to be created instead.

On November 22, 1939, Curtiss set up its Training School at Buffalo. Its immediate aim was to supply the Curtiss Aeroplane Division with 500 young men capable of becoming "helpers" in the plant as soon as possible. Students, ranging from 18 to 26 in age, were to be instructed for from four to six weeks, during which time they were not to be paid. Upon completion of the prescribed course the management promised every effort to put the men to work at a starting wage of 50 cents an hour.

Twenty-six men thus far have been graduated from the school and have secured jobs in the factory. Soon it is expected that about ten young men will be graduated every four or five days. In fact, this emergency school promises to become a permanent fixture.

The training school was started in an old warehouse in Buffalo. On the third floor is an office for R. R. Watkins and E. N. Whittington, founders and supervisors of the school. Behind the office is a machine shop.

At a bench in the shop a dozen youths are constantly busy sorting rivets in dozens of different containers. Here is where the rookies gather to familiarize themselves with various types of rivets and to listen while an instructor explains their importance, uses and kinds.

A number of youngsters at a second bench experiment in drilling holes in scrap stock turned over to the school for practice work. The men drill thousands of holes a day, remaining at the bench until they can do a perfect job, straight down. Materials are assembled and fitted at a third table.

Step by step, at various other benches, students are taught to use the air squeezer to countersink flush-type rivets in such manner that the surface remains satin-smooth; to remove improperly set rivets so that the hole is not enlarged and specifications are strictly followed; to use the hand squeezer and various types of air guns; and to do machine shop work.

The boys must be high school grad-

uates, and preferably should have taken a general course with some manual training, particularly in metal-working. Their progress is mapped by charts. They have daily lessons, special lectures. Aptitudes especially are taken into consideration. Some learn quickly and can be graduated in four weeks. Others are slower and require six weeks.

The training school makes no attempt to give a vocational school education. Curtiss still takes all the graduates from the Burgard Aviation School and from the machine shop course at the McKinley School in Buffalo. The new school supplements these courses; it is a means for securing many more men of the type able and willing to master an exact trade. The graduates often do not remain in the departments to which they are first assigned, being promoted to better jobs.

Much of the student training is concentrated on riveting because riveting is one type of work which can be taught with reasonable ease and because of the large number of riveters required. As a matter of interest, riveters make up about 12 per cent of Curtiss' productive labor. Eighteen per cent are airplane assemblers and the remaining 70 per cent are divided roughly into machinists, sheet metal workers, tool, die and pattern workers, and welders. Because of a new type of construction, cowlings and fusilages are riveted.

Behind the training program at Curtiss is the conviction that it is safer—and a faster process—to train new men "from scratch" than to "untrain" automobile mechanics or machinists used to manufacturing goods which do not require the precision work, accurate dimensions and perfection of detail essential in aircraft production.

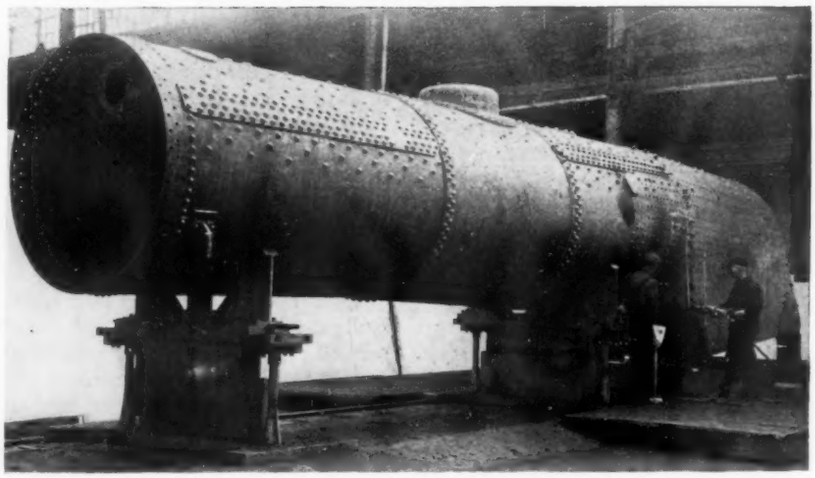
Scores of Buffalo men who consider themselves skilled mechanics go to the Curtiss plant looking for a job and can't understand why their applications are turned down. Says Mr. Mattoon:

"Workers don't realize that the aircraft business doesn't function like the automobile business. An airplane motor cannot be left to an assembly line, nor can an airplane body be pressed out of sheet metal and fastened to a chassis with some bolts. A hidden mistake, and by that I don't mean an intentional one, costs lives. The workman who in an automobile factory forced a rivet into a hole which was a little elongated and found that it did 'just as well' is a menace to our business. Such an incident means a plane that might break in mid-air. Under normal conditions we could take men into the factory and break them in. But there is a time element. It is safer to train our own men."

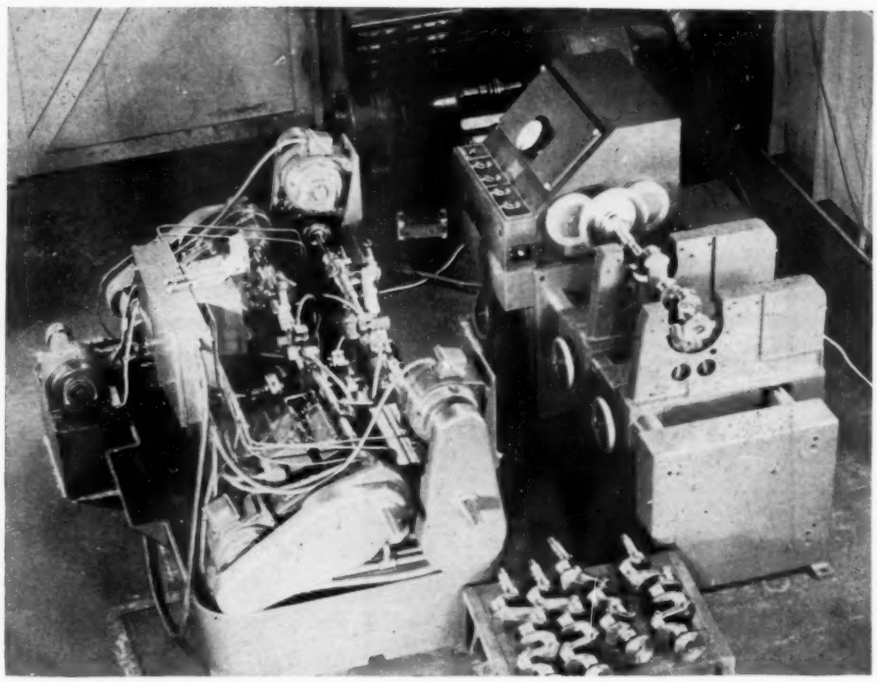
Students learn to use dimpling tools on surface before flush riveting

Lining Up Locomotive Boilers

THE LIMA LOCOMOTIVE WORKS, Inc., is using the illustrated device for lining up the boiler barrel with the firebox before the connecting rivet holes are reamed and the rivets driven. The back end of the firebox, with the mud ring temporarily pinned in position, is located at the correct height by bolting a plate to the mud ring and to a heavy iron bar on the floor, the latter being properly leveled. A similar floor support is moved forward or back to suit any length of firebox, easy and even movement being secured by the round-toothed pinions which mesh into holes in the floor base that act as a rack. One of the pinions can be seen between the two workmen.



Alignment of the barrel is secured by two front supports which are equivalent to V-blocks and adjustable as to height, boiler diameter and distance between their centers. With these front supports properly lined up, it is an easy matter to lower the boiler into position with an overhead crane, set the firebox in place and bring the parts together so that the connecting rivet holes can be reamed in proper alignment before driving the rivets. This method effectively prevents misalignment that can and does happen unless great care is taken.



Crankshaft measurements made in the machine at the right are electrically transferred to the drilling machine at the left. Drills remove the proper amount of material to give balance

Balance Becomes Electric

Alternating voltages created in the magnetic pickups of a balancing machine by crankshaft vibration are converted to drill depths in an automatic machine

ALTHOUGH practically all operations now performed on a crankshaft are done by automatic or semi-automatic machinery requiring only average operator skill, the balancing operation has remained one in which great skill and patience are essential requisites for accuracy. Balancing has generally been the most expensive operation on a crankshaft, often requiring a greater investment in machines and equipment than other operations.

International Harvester has rerecently installed the first of several semi-automatic balancing machines for tractor crankshafts as part of its plant expansion program at Rock Island. Each installation consists of a Gisholt Dynetric unbalance measuring machine electrically connected to a Leland-Gifford automatic drilling machine. These machines are semi-automatic and are arranged to correct for unbalance by drilling four holes in the cheeks, two from each end.

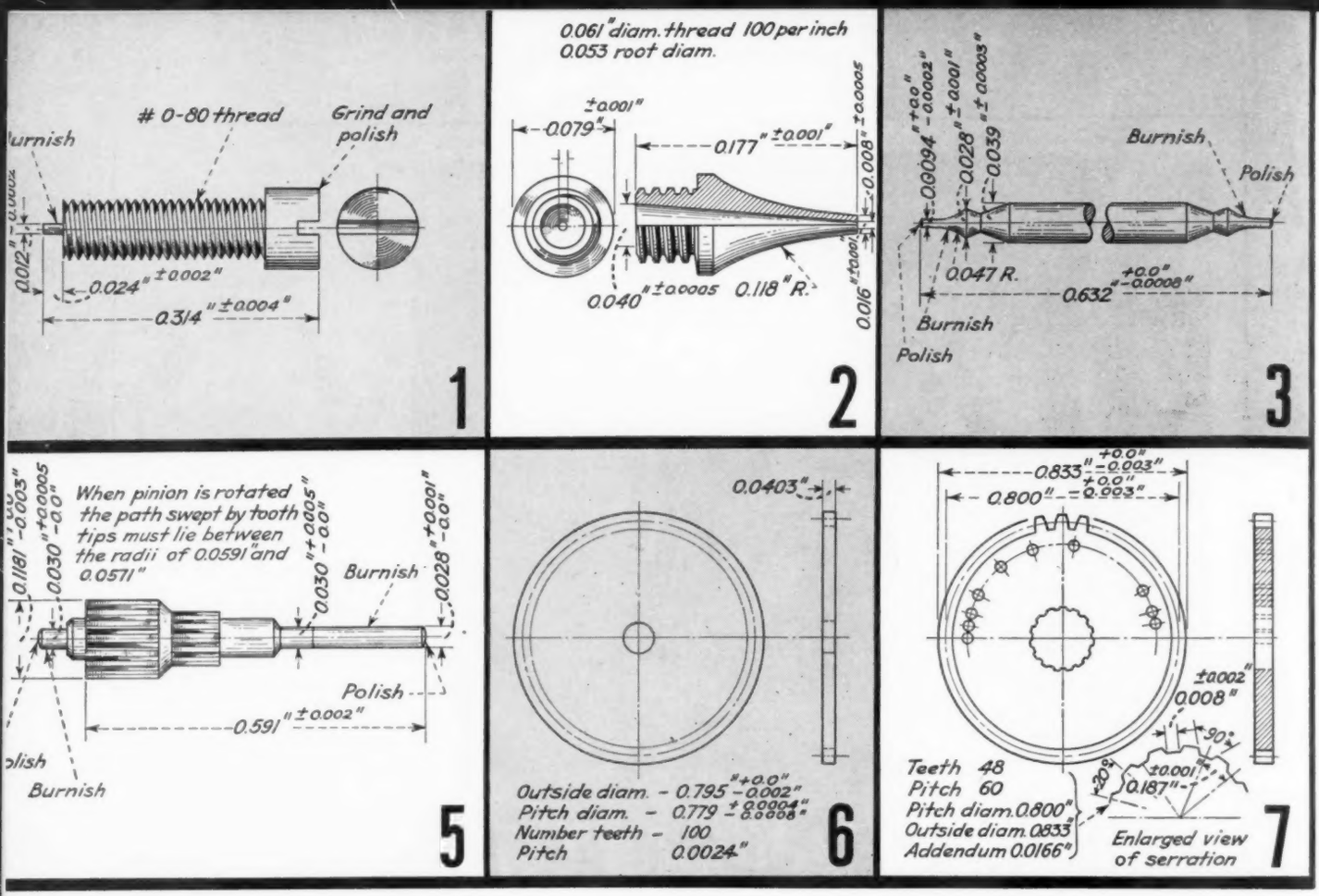
The balancer is arranged to measure the unbalance corrections required at four points that lie in two radial planes which pass through the crankshaft. For example, in a six-throw shaft, one plane contains Nos. 1 and 6 crankpin and the other radial plane contains numbers 2 and 5 crankpins. In this shaft the balancer would measure the correction required in the 1, 2, 5, and 6 pins.

Two carriages on the balancer support a light, flexibly mounted structure which carries the crankshaft. A flexible coupling connects the crankshaft to a driving shaft thus permitting it to vibrate freely in its flexible support. Under rotation the vibrations of the flexible supports caused by unbalance in the crankshaft are transmitted to electromagnetic pickups similar to those used in the electrical production of recorded sound. The alternating voltages generated in these pickups are multiplied in an amplifier in the cabinet at the left of the machine in the illustration.

With a crankshaft in the machine, the operator merely starts the driving motor which rotates the crankshaft through a flexible coupling at balancing speed. He then sets the selector switch at its first position and adjusts the corresponding measuring dial until the meter on the machine reads zero. The selector switch is then moved successively to each of the four positions while the operator adjusts the corresponding measuring dials according to the meter reading. About twenty seconds is required for the measuring process.

An instrument type Selsyn transmitter is attached to each of the measuring dials on the balancing machine. These transfer the four unbalance correction measurements to independent depth settings of each spindle of the automatic four-spindle drilling machines. When the crankshaft has been clamped in the fixture on the drilling machine, the operator moves a lever and all drill spindles rapid traverse close to the crankshaft. Each spindle then continues its advance at the feeding rate. As the drills touch the work they begin to measure the depths which were transferred from the balancing machine. Each drill is automatically retracted as it reaches the set depth.

While one crankshaft is being drilled the operator measures the unbalance in another crankshaft. These measurements in no way affect the crankshaft in the drilling machine.



A job shop for miniature

BY **PIERRE DUMAINE,** SUPERINTENDENT, CUSTOM PARTS DIVISION,

A watch manufacturer turns his skill to the production of precise and intricate custom work

WATCHMAKING, as a trade, has become synonymous with precision. It is natural, therefore, that the watchmaker's skill should be sought by other manufacturers using small parts that must be held to close limits.

To meet this demand, the Waltham Watch Company has set up a separate division, equipped with high quality machine tools which include designs developed by the company's own engineers. Known as the Custom Parts Division, this department is independent of the watch production departments but has the advantage of the fund of knowledge which the company has gained in the production of watch parts and the design of the machines to make them.

Employees in this division are selected watch manufacturing machine operators who have shown special aptitude for the manufacture of intricate and difficult parts. The division now furnishes parts in diameters from ½ in. down to 0.010 in. and in lengths from 6 down to 0.010 ins.

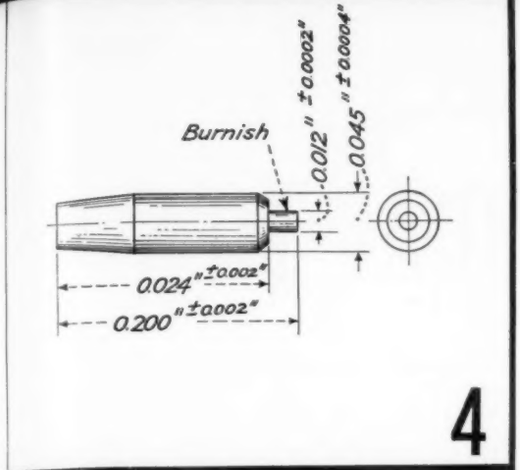
Here are some typical pieces.

Screw Has Pivot on End

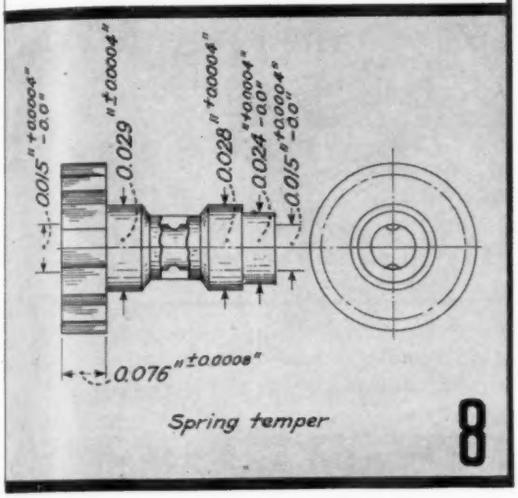
In commercial practice it is difficult to produce a concentric bearing on a shaft which is aligned by a thread. Such a screw, having a pivot on the thread end, is shown in Fig. 1. The first operations on this piece were performed on a Swiss screw machine and consisted of turning the pivot, cutting the thread, forming the head, cutting off and slotting. A second threading operation then was performed because it was necessary to have a clean thread all the way up to the head. Nicking under the head was not permissible. It was only with great care that root diameters and pitch were prevented from distorting. Following the second threading operation, the pivot and pivot face were burnished in a rotary machine. Grinding and polishing operations were performed in a Waltham-type machine originally developed for watch production.

Fig. 2 shows the principal dimensions of a nozzle for a spray gun used for vegetable paints. This nozzle was made from sterling silver so that it would have resistance to corrosion and maintain orifice characteristics. Little information was to be found on the working characteristics of sterling silver, so machining speeds and feeds had to be determined by experiment.

For threading, it was found that the die ran on best at 2,000 r.p.m. and off at 6,000 r.p.m., using standard mineral cutting oil. A cutting



4



8

Every one of these precision parts involved a different problem for the Waltham Custom Parts Division. In the screw in Fig. 1, the pivot had to be concentric with the thread and the thread clean right up to the shoulder. The silver nozzle in Fig. 2 required development of a machining technique all its own. A special type of screw machine solved the problem of machining the extra-long part in Fig. 3, and helped considerably in producing the aircraft instrument spindle in Fig. 4. The blood pressure gage pinion in Fig. 5 required extra care to obtain the proper radius on the pivot end. The tiny gears of Figs. 6 and 7, used in dial gages and motion-picture cameras, had several close tolerances in addition to the usual ones. The watch part in Fig. 8, undertaken as a research problem, was finally produced in 42 seconds

parts

WALTHAM WATCH COMPANY

speed of 2,000 r.p.m. was used for turning the conical portion. These operations were performed on a standard No. 00 B. & S. high-speed screw machine at a cycle of approximately 40 sec. per piece.

A small hand lathe was used to finish these nozzles, two operations being necessary. First, the piece was held by the threaded end in a special chuck and the conical shape finish turned. In the same set-up the hole was spotted and drilled from the small end. Drilling was satisfactory at 8,000 r.p.m. The next operation was to chuck the round stock diameter and taper ream the conical hole. Mineral cutting oil was used and the 0.008 in. hole diameter was held to ± 0.0005 in.

Problem in Long Turning

The turning of long lengths of small diameter in automatic screw machines is sometimes troublesome. Such a job is shown in Fig. 3. This piece of 0.90 carbon drill rod was successfully produced in a 10 sec. cycle in a Petermann automatic screw machine. This Swiss-made machine differs from usual screw machines in that the stock is not fed to the full length of the piece when starting a new cycle. Instead, this machine feeds the length of the piece out gradually as the turning progresses. The required length of stock is obtained by the motion of the head sliding on the bed. Shape of the piece is obtained by tools moving in and out radially.

Precision Instrument Part

Close tolerances must be held for parts for aeronautical instruments, such as the spindle shown in Fig. 4. Made from high-quality drill rod, this part was successfully turned on a Petermann automatic screw machine to ± 0.0002 in. on the 0.012 diameter and ± 0.0004 in. on the 0.045 in. outside diameter in a 30 sec. cycle.

For burnishing the pivot diameter and face, a rotary type machine incorporating a Carboloy circular lap was used. This lap had radial lines so that the face and pivot diameter were finished in one cut.

Miniature Gears Are Difficult

There can be few, if any, errors in tolerances in a gear train for a blood pressure gage. Gears and pinions must roll together with minimum friction. A slight tool mark or a bit of dust might cause an incorrect reading. Fig. 5 shows a pinion for such a train.

This pinion was made from cold rolled steel and has a very fine pitch. The pivots were burnished and the teeth polished all over. The blank was completed in a B. & S. automatic screw machine in a cycle of 16 sec. Teeth then were hobbed in a Type S Barber Colman machine in an 18 sec. cycle. Pivots were burnished in much the same manner as described for Fig. 4, except for the radius on the smaller pivot end. In order to obtain the proper radius, it was necessary to hold the polished piece in a chuck and revolve the chuck through an arc so that the pivot end would contact a hard felt lap.

Some Blanks Stacked

Figs. 6 and 7 show gears used for precision instruments and motion picture cameras. The fine-pitch gear shown in Fig. 7 is used in a camera. First, the piece was blanked and the center hole was pierced. In the second operation the inside of the center hole was serrated, using a special die. Next, the teeth were hobbed, using a standard 60 deg. Acme $\frac{3}{4}$ tooth. Hobbing was carried on successfully with stacks of fifteen blanks in $1\frac{1}{2}$ min. cycles.

Following the hobbing operation, the ten 0.031 in. holes were drilled through the 0.065 in. web. These holes were spaced radially as indicated with a total tolerance variation of 0.5 deg. Three holes had to be held within 0.00125 in. between each other, leaving only a thin wall.

Examination of small gear tooth forms is accomplished in a comparator which projects a 100-diameter image of the piece being inspected.

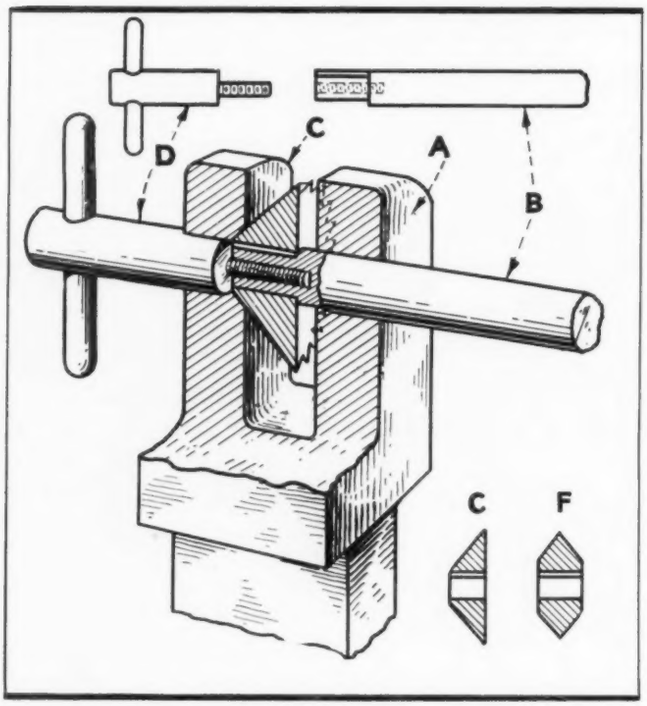
Fig. 8 shows a typical watch part undertaken by this division as a research problem. This piece was completed in a 42 sec. cycle; including drilling and reaming 0.015 in. holes in each end to a tolerance of —0, + 0.0004 in.

IDEAS FROM PRACTICAL MEN

This Cutter Chamfers Inside Holes

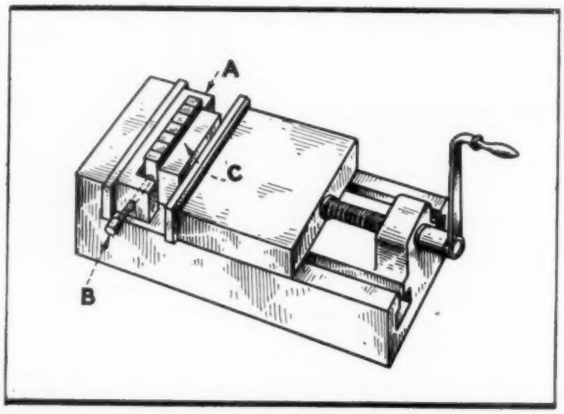
By GEORGE C. LAWRENCE

The tool illustrated was designed for chamfering the inner ends of holes that terminated in a slot, as in the link *A*. The arbor *B* is secured in a chuck in the spindle of the machine and carries the cutter *C* which is keyed to its reduced and internally threaded end and is held thereon by the shouldered stud *D* which also serves as a pilot. The stud has a cross handle so that it can be tightened on the cutter without using a wrench.



Chamfering holes terminating in a narrow slot may look like a difficult job, but it can be easily and quickly done by this simple tool

In use, the cutter is placed in the slot, the arbor is inserted in the cutter and the stud is screwed into the arbor, holding the cutter securely. After the inner end of one hole has been chamfered, the stud is unscrewed and the cutter is removed. For chamfering the inner end of the hole in the other ear of the link, the link is rotated 180 deg. and the tool is assembled as before (but with the cutter in the reverse position). If holes are to be chamfered in a large quantity of links, the double-end cutter *F* can be used and the inner ends of both holes can be chamfered by merely reversing the feed and without disturbing the setting of either the work or the tool.



When milling keys this fixture clamps them in two directions at right angles to each other, in one direction by the clamp and the other by the vise

A Fixture That Aids in Milling Keys

By R. H. PATTERSON

The simple auxiliary clamping fixture illustrated is for use in connection with a milling machine vise for holding keys while the ends are being rounded or squared by the cutter, according to its shape. The device consists of the clamp *A*; the knurled-head clamping screw *B*; and the clamping block *C*.

In use, the keys are held in the clamp by the clamping screw and the loaded clamp is placed in the vise with the clamping block in the position shown. Thus, when the vise is closed the keys are clamped in two directions at right angles to each other. Very short keys can be raised so that their upper ends project above the jaws of the vise by putting a parallel of any desired thickness under them.

Locating the High Spot on Round Work

By ROBERT S. ALEXANDER

The use of a center head of a combination square and a scale, with a level attached to the latter, is undoubtedly a satisfactory method for locating the high spot of a punch mark preparatory to drilling a hole in round stock. This method, described by William S. Rowell (*AM*—Vol. 83, p. 1046) will undoubtedly result in drilling the hole through the center of the stock. However, I have been using a method which is simpler and quicker than the one described.

First I lay out my shaft or round object to be drilled using a keyseat rule and a scriber. Then I prick-punch the location of the hole making a reasonably deep impression. The punch which I use for this pur-

pose is made from ½-in. drill rod with the point ground to a 60-degree angle—same as a lathe center. The striking end is turned down to ⅜ in. for a short distance and rounded to minimize "mushrooming." The work to be drilled is then placed on the drill-press table and the punch goes into the drill chuck. Then before clamping the work in the V-block or vise it is rotated by hand until the punch is brought down and "seated" in the punch-impression; the work is then clamped, the punch removed and the drill inserted. The result being a cross-hole that is central for all practical purposes.

I used the same punch also for starting a tapped hole the thread of which must be "square" with the work. Placing the punch again in the drill-chuck I center the starting tap in the work by means of the center-hole in the squared end, keeping the punch gently, but firmly, in contact with the center hole while turning the tap-wrench. With the hole correctly started, the work can be removed from the drill-press; afterwards, the tapping can be completed in the orthodox manner.

Machining Spherical Surfaces

By STANLEY PORRITT
Engineering Department, Crown Can Company

In the illustrations are shown the lathe set-ups for machining rotating-port valves having spherical mating surfaces. Referring to Fig. 1, the concave member is held in a fixture attached to the faceplate and the compound rest is set at a right angle to the cross-slide. The radius bar *A* is pivoted to a bracket on the tailstock side of the toolblock and to a bracket on the block *B* which is clamped to the lathe bed. The pinion in the apron has been disengaged from the rack so that the carriage is free to travel on the ways. The tool is fed to the cut by the cross-feed screw, the radius bar causing it to describe an arc, and the depth of cut is controlled by the compound rest.

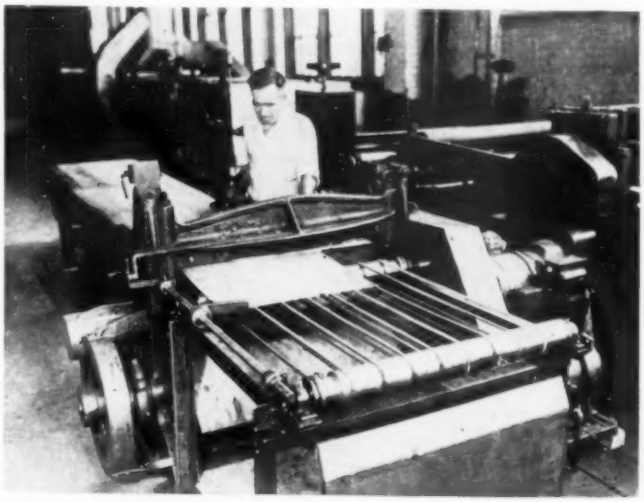
Referring to Fig. 2, the convex member is held on a mandrel supported on centers. The radius bar *A* and the block *B* have been transferred to a point between the cross-slide and the headstock, the bracket on the toolblock to which the radius bar is pivoted being on the side next to the headstock. The compound rest is set to the angle shown to prevent interference with the tailstock.

In both set-ups the point of the tool is in longitudinal alignment with the center of the pin by which the radius bar is pivoted to the brackets on both sides of the toolblock.

Square Shear has Conveyor and Stop

By JOSEPH I. KARASH
Tool Design Department
Reliance Electric & Manufacturing Company

One of the operations in the production of laminations for the armatures and fields of electric motors is cutting the sheets of material in a square shear into



The square shear is shown as it appeared after the multiple V-belt conveyor and the automatic stop were added to reduce operator fatigue and step-up production of armature laminations

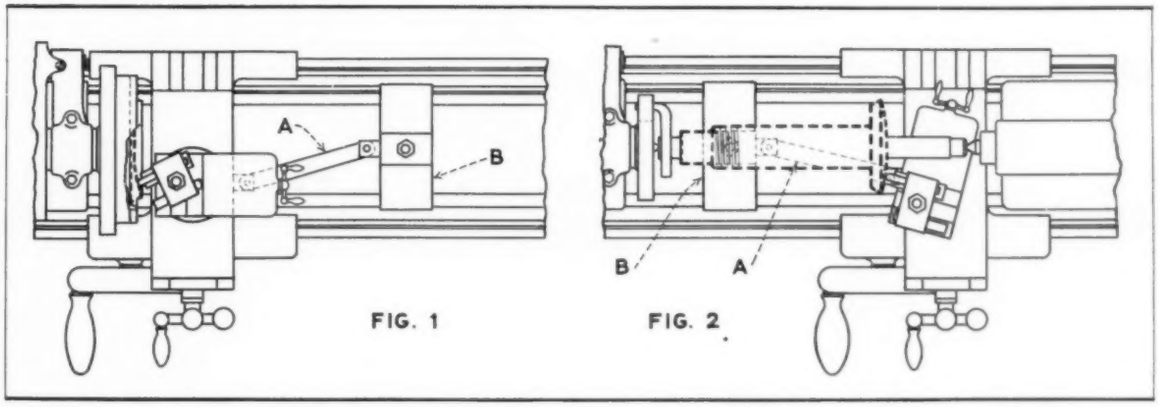


Fig. 1—Set-up for machining the concave member. The radius bar causes the tool to describe an arc as it is fed to the cut by operating the cross-feed. Fig. 2—Set-up for machining the convex member. Both the radius bar and the pivot block have been set between the cross-slide and the headstock

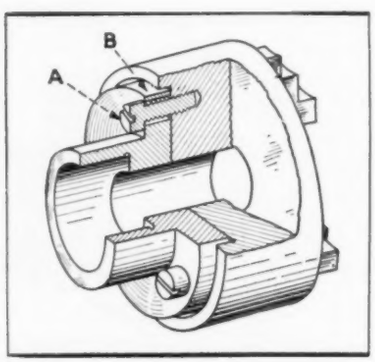
suitable lengths for handling in punch presses. The operation is usually extremely awkward and fatiguing because the operator has to reach around the side of the machine, hold the extended end of the thin and flexible sheet of material against a fixed stop and stand on one foot while he depresses the clutch pedal with the other. In addition he has to dispose of the piece cut off.

To reduce operator fatigue and step up production, I equipped the shear with a multiple V-belt conveyor that not only carried away the piece cut off but supported the extended part of the sheet as well. An automatic stop permitted the piece to pass after it had been cut off. Because of the necessary overlap of the shear blades, the tops of the conveyor belts are below the top of the machine table, otherwise the upper shear blade would depress one end of the piece cut off and cause the opposite end to lift. The hold-down bar, backed by its spring prevents the sheet from shifting while being sheared. The upper shear blade is inclined slightly to give a shearing cut.

In operation, the sheet is slid between the blades onto the conveyor belts and against the automatic stop, being squared against one side of the housing. Then the clutch is engaged and as the upper blade descends the hold-down bar contacts the sheet and holds it in position. As the blade continues its descent the stop is automatically lifted above the level of the sheet. At the bottom of the stroke the piece cut off is carried away by the conveyor. As the blade ascends the stop is lowered until it rides on the piece cut off and, when the piece has passed the stop, the stop drops into position to gage the length of the next piece as the sheet is fed forward. With these additions to the shear the operator can cut up the sheet without moving from the front of the machine, it being necessary only for him to slide the sheet against the stop and engage the clutch.

Truing Chucked Work

By R. B. WARE



Since the chuck would not hold work true, it was changed so that it could be offset the amount of the work runout by tapping it gently with a soft hammer

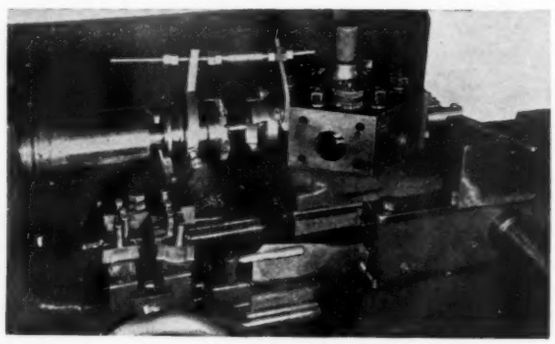
The only chuck I have for my lathe is a three-jaw scroll chuck. It has been in use for a long time and does not hold the work by several thousandths of an inch.

I took off the chuck plate, reamed out the screw holes *A* a little larger and turned down the outer edge *B* for clearance where it fits the recess in the back of the chuck. After putting the plate back on the chuck and tightening the screws, the chuck was put on the spindle and a piece of work was clamped in it. Noting the amount of the work runout, as shown by an indicator, the screws *A* were slightly loosened and the chuck was gently tapped until the work ran true. Then the screws were tightened and I proceeded with my work. Although not ideal practice, the chuck is satisfactory.

Special Bolts Threaded on Turret Lathe

By A. A. LEONHARDI
Rock Island Arsenal

Being in need of a machine for cutting threads on a special bolt with an odd-shaped tapered head we made some changes in a turret lathe, including a die head on the spindle and an adjustable die-releasing attachment, which worked successfully in turning out production quantities of the bolts. Although this particular arrangement was used to thread the bolts shown on the carriage of the lathe, we have since fixed another turret lathe to cut threads on a bolt 18 in. long, and with a special tapered head, by using a different holding device.



This turret lathe was fitted with a die on the spindle to thread bolts with special heads. The die is released when the collar around the die is contacted by nuts on the adjustable bolt bracketed to the side of the turret

A revolving die is placed on the spindle. The die is released when the fixed bolt attached to the turret contacts the adjustable-length bolt on the collar around the revolving die. Adjustment of this bolt controls the length of thread.

In this particular set-up the tapered head of the bolt is held tightly in the tapered slot by a plunger rod held with spring pressure. This rod and spring pass through the center of the turret. When the turret returns to loading position the lever at the right, being held by the sheet metal guard, releases the threaded bolt by pulling plunger rod back against the pressure of spring. The threaded bolt can then be unloaded and an unthreaded bolt loaded. Returning the turret to the threading position automatically allows the spring to move the plunger against the bolt head.

The Working of HIGH-SPEED STEELS

AMERICAN high-speed steels had their inception with research done about 1900 by Frederick W. Taylor and Maunsell White in the Bethlehem Steel Company's plant. In 1903, Dr. J. A. Mathews of the Crucible Steel Company of America discovered that addition of one per cent vanadium to the Taylor & White analysis showed improvement. This work resulted in the 18-4-1 type of high-speed steel.

The enormous amount of development work done since the turn of the century has had two objectives: (1) to bring out more highly alloyed materials to meet specific machining problems in various industries, and (2) to cut cost of the steels by substitution of molybdenum for tungsten. At present there are eight distinct classifications of tungsten high-speed steels. Since 1930 there has been considerable work on producing molybdenum high-speed steels in similar categories.

ALLOYING ELEMENTS

Carbon—The carbon content of high-speed steels is important because, with alloy constituents remaining constant, the hardness and toughness of the steels will vary with the carbon content. This may range from 0.50 to 0.85 per cent, and can be obtained in five to ten point steps within this range, depending on the type of high-speed steel desired. The 0.50-0.60 carbon range is usually used only for tools for hot work. The 0.61-0.67 carbon range is ordinarily specified for tools in which toughness is particularly important and hardness under Rockwell C-62 is satisfactory. Warehouse stock for metal-cutting tools is mainly confined to the 0.68-0.74 carbon range where a Rockwell hardness of C-62 is desired. Higher carbon ranges are available for tools requiring great hardness.

Tungsten — In commercial high-speed steels containing from 14-22 per cent of tungsten, this element has two principal functions: formation of permanent, hard, abrasion-resisting carbide particles, and (2) development of "red hardness", or ability to retain hardness while cutting at red heat. Tungsten is capable of these results when used with other elements, notably chromium and vanadium.

Chromium—This element enters into solid solution in the matrix, imparting toughness to the steel. It also contributes to the hardness, in part, by forming carbides.

Vanadium—Excessive grain growth is inhibited by vanadium. It enters into solid solution in the matrix and in small part forms carbides. It increases impact strength, yield point, elastic limit and cutting ability of high speed steels. With increasing amounts of vanadium, Rockwell C hardness is slightly reduced. However, the beneficial effects of vanadium can be retained without a reduction in hardness if the increase in vanadium is accompanied by an increase in carbon content.

Cobalt—The addition of cobalt increases the "red hardness" characteristics of high-speed steels. It is useful in tools used on heavy cuts where excessive heat is generated at the cutting surface. It also increases somewhat the tendency of steels to decarburize in forging and heat-treating.

Manganese and Silicon—These elements are not present as definite alloying elements in the high-speed steels. Their principal uses are as deoxidizing agents and, in the case of manganese, as a scavenger by combining with the sulphur in the steel. They both usually are held to less than 0.35 per cent, at which amount neither present any difficulties. If the manganese content, however, exceeds 0.35 per cent it may cause excessive breakage in heat-treating.

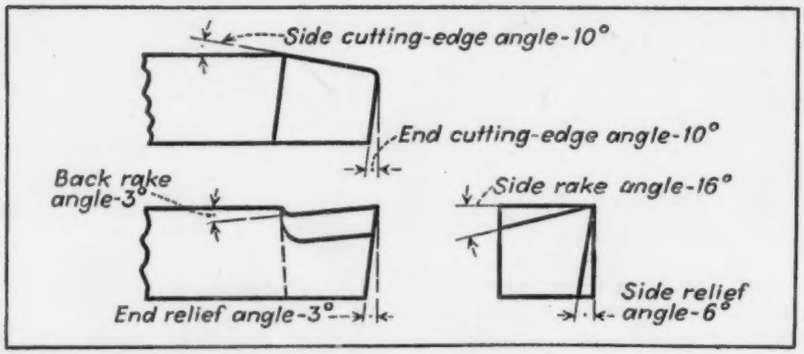
Molybdenum—One per cent of molybdenum is approximately equivalent in alloying effect to two per cent of tungsten. In the early stages of development of molybdenum type high-speed steels, difficulties were encountered with decarburization at elevated temperatures, and with the necessity of holding to a narrow range of quenching temperatures in heat-treatment. These difficulties have been largely overcome with improved forging and heat-treating methods.

Due credit is given the following organizations for data supplied by them toward preparation of this section:

Ajax Steel & Forge Company
Allegheny-Ludlum Steel Company
Braeburn Alloy Steel Company
Carpenter Steel Company
Continental Machines Inc.
Crucible Steel Company of America
Henry Disston & Sons, Inc.
Ex-Cell-O Corporation
Firth Sterling Steel Company
Gairing Tool Company
Goddard & Goddard Company
Gorham Tool Company
Haynes Stellite Company
E. F. Houghton & Company
Jessop Steel Company
Latrobe Electric Steel Company
The Midvale Company
Midwest Tool & Mfg. Company
National Broach & Machine Company
National Twist Drill & Tool Company
Simonds Saw & Steel Company
The Texas Company
Universal-Cyclops Steel Corporation
Vanadium Alloys Steel Company
Vulcan Crucible Steel Company
Winter Brothers Company

MACHINING HIGH-SPEED STEELS

Which is the best high-speed steel to use? The answer is bound up with such matters as: (1) cost of the material, (2) requirements of the job, and (3) equipment and experience available for heat-treatment. Obviously, a highly alloyed type of steel costing four to five times as much as the common grades will not be specified unless there is some particular problem in the application, such as heavy cuts, gritty surface, or tough, abrasive, or heat-treated material.



Single-point tools for machining high-speed steels have the same rake and clearance angles as for S.A.E. 3140 nickel steel

In general, annealed high-speed steels are machined like S.A.E. 3140 nickel steel. There is little difference in machineability so far as the various types of high-speed steel are concerned. The usual criterion in cutting tool plants is to run the job fast enough to produce a blue chip. What slight differences exist are as follows: (1) molybdenum steels are somewhat easier to machine than the tungsten types, and (2) either type containing appreciable percentages of cobalt and more than one per cent vanadium are somewhat more difficult to machine than the lower-alloyed types.

Cutting speed ordinarily runs about 70 surface ft. per min., when hardened high-speed steel tools are used upon annealed high-speed steel. High cobalt steels may require a 10 per cent reduction in this figure. Some Stellite J Metal is employed for roughing operations and for turning down the flash at the butt-welded joint between a high-speed steel tip and a nickel-steel shank. For the latter operation the cutting speed is from 85-115 ft. per min., feed from 0.015 to $\frac{1}{32}$ in., and depth of cut $\frac{1}{16}$ in. No data are available concerning the use of cemented carbides on high-speed steels. Cutting-tool manufacturers commonly fabricate their own tools from waste ends, a practice which has been found satisfactory.

The Brinell hardness of the high-speed steels is important in machining. Too low hardness causes the material to become gummy and tear, and tools to dig in and break. Several cutting tool plants specify about 225 Brinell, but one asks that all forgings be annealed to 170-220, and finds that 180-190 Brinell gives the best results in the shop. But on intricate form tools, the Brinell hardness may be 250 or more in order to permit machining without tearing.

DRILLING

Drills for high-speed steels should have a point angle of 135 deg., clearance of 7 deg., and the web thinned to 50 per cent of the original thickness. Surface speed is 70 ft. per min., and feeds according to conventional practice for steel; these feeds range from 0.004 in. per revolution for $\frac{1}{8}$-in. drills to 0.016 in. per revolution for 1-in. drills.

REAMING

Conventional expansion reamers are being used successfully in reaming straight holes, and permit ease of set-up on machine arbors. In some cases, a disk-type reamer has been found to give better tool life and finish than a conventional reamer when reaming holes in milling cutters. For taper holes, roughing reamers have a 15-deg. right-hand spiral; for finishing, a 28-deg. left-hand spiral and only 0.005 in. land. For turret-lathe reaming, coolant suggested is twenty parts water to one part soluble oil.

BROACHING

High-speed steels show a tendency to form a built-up edge on the teeth of conventional broaches, and for this reason the operation is sometimes avoided for sizing round holes. Good results are being obtained, however, by pitching the teeth to take a 0.005 in. cut per tooth and by altering the face angle from the conventional 10-15 deg. to 5 deg. because of the density of the material. Keyway broaching is being done satisfactorily in regard to speed and finish with conventional broaches.

MILLING

Climb milling is preferred by cutting tool manufacturers where the correct type of machine is available, because feeds can be increased from 30 to 50 per cent as compared with up cutting, finish is improved and the life between grinds may be extended 200 per cent. Cutter teeth ordinarily have an 8 to 10 deg. positive rake, 7 to 8 deg. clearance and no land. For straight up cutting, the hook on the teeth has been modified to 5 deg. to achieve better results. Speeds, feeds and depth of cut ordinarily follow practice used on nickel steel. But surface speeds up to 130 ft. per min. are being used for climb milling, with a cut per tooth of 0.005 in., positive rake of 15 deg. and clearance of 4 deg.

Some shops prefer to use cutters that have been given a proprietary "hard case" treatment following heat-treatment whereby a case from 0.003–0.004 in. is secured. A coolant that

Raker-set bandsaw blades with 10–14 teeth per inch are preferred for high-speed steels. Cutting speeds range from 100–150 ft. per min. For a $\frac{3}{8}$-in. width saw, a feed pressure of 55 lb. is recommended

BANDSAW CUTTING TESTS ON HIGH-SPEED STEELS

Material	Saw Pitch Teeth per Inch	Saw Speed Ft. per Min.	Cutting Results Seconds per sq. in. cut
18 W-4 Cr-1 V.....	12	100	90.5
18 W-4 Cr-2 V.....	12	100	123.0
8 Mo-4 Cr-1 V + 1.5 W....	14	150	82.0

The steels were in the annealed condition. All saws cut more slowly at the beginning than at the end of a 30-in. cut, the increase in cutting-off rate being from 16–41 per cent.

has proved satisfactory, but is not commonly known, consists of one part sulphurized oil cut back with one part pale paraffin oil.

HOBBING

A feed of 0.020-0.030 in. is ordinarily used in hobbing, according to diameter of the work. Hob teeth are customarily ground on a radial line.

TAPPING

Tapping the high-speed steels is an intermittent operation, and no standard practice is recognized. Taps with a long chamfer are frequently started by machine to keep them straight, and the operation is finished by hand. Power required to operate coarse-pitch taps in high-speed steel is considerable, and consequently both roughing and finishing taps are used. Coolants used by cutting tool plants vary as follows: (1) two parts white lead and one part lard oil, (2) sulphurized mineral oils plus 25 per cent carbon tetrachloride—a mixture which is said to have helpful effects in heavy cutting, and (3) ordinary cutting oils, with or without fine powdered lithopone.

BANDSAWING

Cutting tests made upon annealed tungsten high-speed steels in the 18-4-1 and 18-4-2 analyses and upon the 8-4-1+1.5 W molybdenum type show that the metal thickness encountered in average work will not affect the pitch of the saw. Ordinarily, the pitch ranges between 12-14 teeth per inch, but in no case should it go below 10 teeth except where material is less than 0.25 in. thick.

A raker-set saw was used with these alloys. A $\frac{3}{8}$-in. width of saw and a pressure of 55 lb. to feed the work into the saw were found satisfactory in cutting off 1-in square bars. For contour work, the width of the saw will depend upon the minimum radius to be cut. No coolant was found necessary in these cutting tests, but twenty parts water to one part soluble oil is commonly used in shops where cutting off is on a production basis.

MACHINE FILING

The best filing speed for the above three types of steel was found to be 100 surface ft. per min. Pressure will depend upon the nature of the work, but it should be uniform. An average of 20-40 lb. is considered satisfactory. A bastard-cut file should be used for all except finish filing, which requires a mill-cut type.

GRINDING

An exact selection of the correct grinding wheel for a particular job of toolroom grinding on a high-speed steel tool depends on such factors as: (1) the job, (2) the machine and its condition, (3) the speed of grinding, (4) the finish required, (5) contact of wheel on work, (6) the skill of the operator, and (7) to some extent on the kind of high-speed steel involved. These factors vary from shop to shop.

Few shops must grind all types of high-speed steels. The consumption of high-speed steel containing more than 18 per cent tungsten, 4 per cent chromium and 2 per cent vanadium, or similar molybdenum steels, is limited. Steels more highly alloyed than these present serious grinding problems, each of which must be solved on its own merits.

Aluminum-oxide wheels should be used on all high-speed steels except those containing high percentages of cobalt or vanadium. Such steels are so dense and hard that silicon-carbide wheels are preferred. Suggested silicon-carbide wheels range between 60-120 grain in soft and medium grades. These wheels are mainly for use in exceptional circumstances, and only for light finishing cuts. Sometimes, an organic bond may be necessary.

But for most classes of steels, aluminum-oxide wheels are suggested in

CUTTING OILS FOR HIGH-SPEED STEELS*

Operation	Tungsten Types	Molybdenum Types
Grinding	50 to 75 W + 1 SO (F)	50 to 75 W + 1 SO (F)
Cold sawing (high speed)	15 to 20 W + 1 SO	15 to 20 W + 1 SO
Cold sawing (slow speed)	SM (1) LM ML (3)	SM (1) LM LM (3)
Drilling, hobbing, milling	SM (1) or SM (2) LM ML (3)	SM (1), SM (2), SM (3) LM ML (3)
Boring, turning, planing, shaping	15 to 20 W + 1 SO SM (1) or SM (4) LM ML (4)	10 to 20 W + 1 SO SM (2) or SM (4) LM ML (4)
Reaming	SM (2) or SM (4) LM ML (4)	SM (3) or SM (4) LM ML (4)
Broaching — (Roughing) under 1 in.	SM (2), SM (3) LM ML (1)	SM (3) LM ML (1)
Broaching — (Roughing) over 1 in.	SM (3), SM (4) LM ML (2)	SM (4) LM ML (2)
Broaching — (Finishing) under 1 in.	SM (1), SM (3) LM ML (3)	SM (2), SM (3) LM ML (3)
Broaching — (Finishing) over 1 in.	SM (2), SM (4) LM ML (4)	SM (3), SM (4) LM ML (4)
Tapping	SM (2)	SM (3)

* This table embodies the general recommendations of major oil companies. The type of material has little effect upon the cutting-oil recommendation, but the types of oils mentioned for a given application must vary widely because of such factors as machine, speed and depth of cut. Other recommendations in the accompanying text give the suggestions advanced by several cutting tool manufacturers.

Legend: W — Water; SO — soluble cutting oil; SO (F) — soluble cutting oil processed to remove grit and dirt; SM — sulphurized fats plus mineral oil. Numbers in parentheses indicate cutting strength, No. 4 being the strongest; LM — straight mineral oil; ML — mineral lard cutting oil. Numbers in parentheses indicate the percentage of lard oil in the blend, No. 4 being the highest. Mechanics usually prefer the lighter-colored mineral lard oils.

the following ranges: from 36-80 grain in soft and medium grades, with the 60-grain predominating. In the harder and denser types of these steels it may be necessary to go to an 80-grit wheel for some surfacing operations, and for form grinding a wheel of 80 grain might be used. For steels hardened to Rockwell C 65 or more, it is often necessary to use high-purity wheels (those free of iron oxide) because these wheels cut cooler. Vitrified wheels are preferred for practically all operations, but resinoid-bonded wheels are used for a few applications such as cutting off, grooving counterbores and some chaser grinding, because their cooler cutting action prevents burning or checking the work under practically all operating conditions.

CLASSIFICATION OF HIGH-SPEED STEELS BY MANUFACTURER AND TRADE NAME

Tungsten High-Speed Steels

18%-W 4%-Cr 1%-V

Manufacturer	*Brand*
Allegheny-Ludlum	LXX
Bethlehem	Bethlehem Special HS
Braeburn	Vinco
Carpenter	Star Zenith
Columbia	Clarite
Crucible	Rex AA
Disston	Kutkwik
Firth-Sterling	Blue Chip
Halcomb	Dreadnaught
Jessop	Supremus
Latrobe	Electrite No. 1
Midvale	Two Star
Simonds	Red Streak
Universal-Cyclops	B-6
Vanadium	Red Cut Superior
Vulcan	Wolfram

18-W 4%-Cr 2%V

Manufacturer	*Brand*
Allegheny-Ludlum	ML
Bethlehem	HV
Braeburn	Twin Van
Carpenter	Super Star Zenith
Columbia	Vanite
Crucible	Rex Super Van
Firth-Sterling	HV Blue Chip
Halcomb	Super Van Dreadnaught
Jessop	Supremus Extra
Latrobe	Electrite No. 19
Midvale	Two-Star Special
Simonds	Lockport Special
Universal-Cyclops	B-9
Vanadium	EVM
Vulcan	Super HS Steel

18%-W 4%-Cr 3¼%-V

Manufacturer	*Brand*
Latrobe	Electrite Vanadium

18%-W 4%-Cr 1%-V 4%-Co

Manufacturer	*Brand*
Allegheny-Ludlum	Panther Special
Bethlehem	Comokut
Crucible	Rex AAA
Halcomb	Baltoc
Jessop	Purple Label
Latrobe	Electrite Cobalt
Midvale	Three Star
Simonds	Tunco
Universal-Cyclops	B-7
Vanadium	Red Cut Cobalt
Vulcan	Wolfram Cobalt

18%-W 4%-Cr 2%-V 8%-Co

Manufacturer	*Brand*
Allegheny-Ludlum	Super Panther
Braeburn	Bonded Carbide Jr.
Crucible	Rex 18-8
Disston	D-6 Co.
Firth-Sterling	Circle C
Latrobe	Electrite Super Cobalt
Midvale	Four Star
Simonds	Super Cobalt
Universal-Cyclops	B-10
Vanadium	Red Cut Cobalt B

22%-W 4%-Cr 1.50%-V 12%-Co

Manufacturer	*Brand*
Braeburn	Bonded Carbide
Crucible	Rex 440
Latrobe	Electrite Ultra Cobalt
Midvale	Five Star
Vanadium	Grey Cut Cobalt

14%-W 4%-Cr 2%-V

Manufacturer	*Brand*
Bethlehem	Extra Special HS
Braeburn	Gyro
Crucible	Rex Champion
Firth-Sterling	Star Blue Chip
Halcomb	Super Dreadnaught
Jessop	Jessco
Latrobe	Electrite Uranium
Midvale	One Star
Universal-Cyclops	B-42
Vulcan	No. 14

14%-W 4%-Cr 2%-V 5%-Co

Manufacturer	*Brand*
Braeburn	Cobalt
Carpenter	Gold Star
Columbia	Maxite
Crucible	Rex 95
Halcomb	999
Jessop	Jessco B
Latrobe	Electrite Uranium B.
Midvale	Three Star
Universal-Cyclops	B-8

Molybdenum High-Speed Steels

8%-Mo 4%-Cr 1%-V 1.50-W

Manufacturer	*Brand*
Allegheny-Ludlum	LMW
Bethlehem	Bethlehem H-M
Braeburn	Mo-Cut
Carpenter	Star-Max
Crucible	Rex Tmo
Disston	Di-Mol
Firth-Sterling	H-M Blue Chip
Jessop	Mogul
Latrobe	Tatmo
Simonds	S.T.M.
Universal-Cyclops	Motung
Vulcan	Vulmo

4%-Mo 4%-Cr 1.5%-V 4%-W

Manufacturer	*Brand*
Allegheny-Ludlum	D. B. L.
Braeburn	" 5-5 "
Disston	66
Universal-Cyclops	Motung 54

8%-Mo 4%-Cr 1.5%-V 8%-Co Boron Added

Manufacturer	*Brand*
Firth-Sterling	Super Mo-Chip
Universal-Cyclops	Super Motung Special

9%-Mo 4%-Cr 4%-V

Manufacturer	*Brand*
Vanadium Alloys	Neatro

6%-Mo 4%-Cr 1.5%-V 6%-W

Manufacturer	*Brand*
Latrobe	Electrite Double Six

8%-Mo 4%-Cr 2%-V

Manufacturer	*Brand*
Columbia	Molyite
Crucible	Rex V. M.
Latrobe	Electrite Tatmo B
Vanadium	Van-Lom
Universal-Cyclops	Mo-Van B

8%-Mo 4%-Cr 1%-V 2.5%-Co Boron Added

Manufacturer	*Brand*
Firth-Sterling	Mo-Chip

8%-Mo 4%-Cr 1%-V 1.50%-W 4%-Co.

Manufacturer	*Brand*
Braeburn	Co-Mo
Latrobe	Electrite Tatmo A
Universal-Cyclops	Super Motung

HEAT-TREATMENT

Much high-speed steel reaches the ultimate consumer in the form of fabricated tools or toolbits. However, often the consumer makes tools from forgings sheets, bar stock, drill rod and special sections. Forgings are usually obtained from the steel mill or from local jobbing forge shops equipped to handle high-speed steels.

Working the high-speed steels has only one object in view—attaining maximum cutting efficiency. The methods cited herein for forging, annealing, preheating for hardening, hardening, quenching and tempering are intended to represent average acceptable practices.

Hardness is perhaps the most common method of judging the cutting ability of a tool made from a given basic analysis of high-speed steel. But the hardness that is suitable for one tool and its application may be entirely wrong for another set of conditions. Thus, heat-treatment is varied to obtain the best combination of hardness and toughness (resistance to chipping and spalling during cutting, and not toughness as commonly measured by various tests, of which it is said that they do not approximate the conditions of service).

Heat-treating strives to apply high enough heats to take into solution as many carbides as possible and to attain a uniformly austenitic condition. Quenching from these high temperatures endeavors to retain that structure, one in which spheroidal carbides are comparatively small and well distributed.

The higher the quenching temperature, the better the resulting cutting ability, but certain limitations arise in practice: (1) development of an intergranular austenite carbide structure that induces brittleness, (2) grain coarsening which adversely affects the impact strength, (3) possible decarburization, and (4) burning of fine cutting edges.

By tempering or drawing the quenched steel, the austenite retained in quenching is decomposed into a hard needle-like martensitic structure, which gives rise to the cutting properties of high-speed steel. A properly quenched structure should be uniformly martensitic but the needles must not be too large.

An increase in quenching temperature tends to increase the carbides in solution, the grain size and the cutting ability, but it is a matter of argument whether an increase in grain size is synonymous with an increase in cutting ability. However, too great an increase in grain size adversely affects the resistance of a tool to chipping under severe conditions of interrupted cutting.

Grain size can be controlled through attention to time and rate of heating, and the temperature attained by the work in the high-heat furnace. All three of these are variables which are affected by the heating medium, the equipment and the temprature indicating means. They will be discussed further under the subject of "Hardening."

In a recent cutting efficiency test, several 18-4-1 tools were supplied by as many vendors and showed about equal cutting efficiency despite variance in heat-treating practice. Each tool manufacturer had established time and rate of heating, plus temperature of the work, which would give the best results from his equipment.

Tools are frequently said to be too soft, when actually they are too hard. Toughness is impaired, and embrittlement of the cutting edge causes minute chipping. The tool dulls, then fails and shows a so-called "burnt edge." The minute chipping is concealed as the cause of failure. The remedy, says one authority, is to temper the steel to a higher temperature, thereby reducing the hardness and gaining sufficient toughness to support the cutting edge.

CHEMICAL COMPOSITION OF HIGH-SPEED STEEL—PER CENT*

—Alloy Constituents and Symbols—					
Tungsten W	Molybdenum Mo	Chromium Cr	Vanadium V	Cobalt Co	Boron Addition
Tungsten High-Speed Steels					
18		4	1		
18		4	2		
18		4	3¼		
18		4	1	4	
18		4	2	8	
22		5	1.5	12	
14		4	2		
14		4	2	5	
Molybdenum High-Speed Steels					
1.5	8	4	1		
5	4	4	1.5		
	8	4	2		
	8	4	1	2.5	Yes
1.5	8	4	1	4	
	8	4	1.5	8	
	9	4	4		Yes
6	6	4	1.5		

* The percentage of alloying elements may vary slightly, according to the practice of the individual supplier.

ANNEALING

Tungsten Steels—Preferred practice is to place tungsten high-speed steel forgings or tools in a container and surround them with some non-oxidizing material to prevent decarburization. Some large forge shops use an electric furnace and closely control the heating and cooling rates. Annealing temperature is usually 1,600-1,650 F. For variations, because of composition, see table of heat-treating temperatures.

The steel is held at annealing temperature for 2 to 6 hr., according to size. Another rule is 1 to 2 hr. per inch of heaviest section. At the end of the annealing period, close all furnace openings and allow the container to cool with the furnace. Softness depends upon the rate of cooling. Cooling from the annealing temperature to 1,000 F. should not exceed 35 F. per hour.

Molybdenum Steels — Annealing temperatures for molybdenum steels are about 50-100 deg. lower than for the tungsten types. Pack annealing is also suggested. Sometimes as much as 10 per cent carbonaceous material is added to the non-oxidizing packing material, but distinct carburization of the steel can take place if the annealing time is too long. The minimum time at annealing temperature is ordinarily specified as one hour per inch of thickness. For maximum softness the cooling rate should be 30-40 F. or less per hour down to 1,200 F., after which the process can be accelerated. Forging or machining strains are frequently relieved at 1,550-1,600 F.

PREHEAT FOR HARDENING

Tungsten Steels—A soaking preheat in the neighborhood of 1,600 F. is required for tungsten high-speed steels because the quenching temperatures are high—up to 2,400 F. in some cases. Two preheating furnaces are often used. The first at 1,200 F. acts as a reservoir for the work, and tools can remain in it for a considerable period without detriment. The second is maintained in

the 1,600-1,800 F. range. Preheating must be done slowly and uniformly, particularly on large tools or those where distortion must be held to a minimum.

Molybdenum Steels—These steels are preheated to a temperature range about 100 deg. lower than for the tungsten types. When a double preheat is used, the first one is carried out at about 1,250 F. Work intended for open-furnace hardening must be coated with borax by dipping in a solution prior to preheating, or by sprinkling borax on the preheated pieces. Borax must not be used if salt bath hardening is to follow, and is not required in some controlled-atmosphere hardening furnaces.

Controlled atmospheres that have been used in preheating are:

(*a*) Carbon dioxide — 7.2 per cent; carbon monoxide—4.4 per cent; oxygen—none.

(*b*) Carbon dioxide — 10.5 per cent; carbon monoxide—2.0 per cent.

(*c*) Carbon monoxide — 35 per cent; hydrogen—not to exceed 3 per cent; nitrogen—the balance.

One authority, who has done considerable work with controlled atmospheres for both preheating and hardening, states that his first choice is an equilibrium atmosphere containing 35 per cent CO, and that his second choice is an atmosphere just below the neutral point, or one containing 0.5 O_2. The explanation advanced is: where an atmosphere drops back more than a few per cent under maximum CO, decarburization occurs with increasing rapidity down to the point where minor scaling begins, which seems to inhibit decarburization. These comments apply alike to the preheating and hardening of tungsten and molybdenum steels.

HARDENING

Tungsten Steels—Immediately following preheating of tungsten steels, transfer the piece to the high-temperature furnace, and heat to the portion of the hardening range suited to the work. Delicate tools are ordinarily heated to the lower portion of the range, lathe tools to the upper portion.

The furnace can be a muffle type—electric, gas or oil fired—or a salt bath. Muffle furnaces may use carbon blocks, a gas curtain or controlled atmosphere for protecting the work. Some tools are hardened successfully in gas-fired semi-muffle furnaces at temperatures between 2,300 and 2,400 F. Hardening temperatures are sometimes limited in fuel-fired furnaces by blistering and pitting. Alligator-skin surface is indicative of too much oxygen in the furnace atmosphere rather than too much heat. When controlled-atmosphere furnaces are used, however, it is possible to use full hardening temperature on delicate tools without damage.

In any case, the tool should be brought to the desired temperature quickly and held there only a short period, usually measured in a few minutes. Prolonged soaking is undesirable because of its effect upon grain size and surface of the tool.

Definite times for holding tools at hardening temperatures are impossible to establish because of (1) variance in form and size of tools, and (2) the rate of heat transfer varies with the medium and the type of furnace. Salt baths transfer heat the most rapidly because a liquid is a faster heating medium than a gas. Usually a semi-muffle furnace transfers heat more rapidly than a full-muffle type. Composition of the atmosphere also affects heat transfer.

Control of grain size is important because of its effect upon toughness. Grain size is affected by time, temperature and rate of heating. Tools are said to reach the temperature indicated by thermocouples according to type of furnace in this order: (1) salt bath, (2) semi-muffle furnace, (3) full-muffle furnace. To produce comparable grain size using about the same time in the furnace, a salt bath will be operated about 25 deg. lower than a semi-muffle furnace, and a semi-muffle furnace from 25-35 deg. lower than a muffle furnace with controlled atmosphere.

The above remarks apply to all high-speed steels of the tungsten type with these exceptions: The 18-4-2 analysis can be held at the hardening temperature slightly longer than 18-4-1, because the steel is not endangered by longer soaking and the alloys will go into solution better. For the 18-4-3 analysis the hardening temperature must not exceed 2,300 F., or the edges of tools will be burned.

Cobalt types such as 18-4-2+4 Co and 18-4-2+8 Co can be heated slightly longer than 18-4-1, because they are less susceptible to grain growth. A slight soak is required for the highly alloyed 22-5-1.5+12 Co material. The 14-4-2+8 Co analysis will withstand high quenching temperatures without excessive grain growth, but is considered by some as being as bad or worse than molybdenum steel in respect to decarburization. Generally, 14-4-2+8 Co steels should be held in the furnace only one-half to one minute after reaching approximately the furnace temperature. The holding time depends somewhat on the form involved. Success in preventing surface impairment is reported by several sources through using a controlled atmosphere consisting of 35 per cent carbon monoxide, not more than 3 per cent hydrogen, and the balance nitrogen.

Molybdenum Steels—The molybdenum high-speed steels develop their secondary hardness and maximum strength from quenching temperatures slightly lower than for the tungsten types. Some users find that a more narrow range of quenching temperatures will produce more consistent results in hardening.

Decarburization is minimized in open-furnace hardening by the application of borax, by dipping in a solution prior to preheating, or by sprinkling borax upon tools heated to the preheating temperature. Certain air-hardening types of molybdenum steels like 8-4-1+1.5 W can be protected against decarburization by the application of special copper-bearing paint, instead of borax.

Decarburization in muffle furnaces can be controlled by placing the tools in carbonaceous blocks, by the use of a gas curtain, or by introduction of controlled atmospheres. Three compositions for the last are:

(*a*) Carbon dioxide—7.4 per cent; carbon monoxide—4.8 per cent; oxygen—none.

(*b*) Carbon dioxide—4.5 per cent; carbon monoxide—15 per cent; oxygen—none.

(*c*) Carbon monoxide — 35 per cent; hydrogen—3 per cent; nitrogen—the balance.

Preheating atmospheres to precede these hardening compositions were given earlier, and should be matched in regard to type number. Furnace atmospheres containing carbon dioxide are considered by some authorities as deleterous to cobalt-bearing steels like 8-4-1.5+4 Co.

Hardening is also being done in salt baths. Distortion is being held to low limits, and work that it is undesirable to grind after hardening is being produced free of scaling or pitting. Use of borax is omitted in salt-bath hardening to prevent contamination of the salt.

Preheated molybdenum steels are transferred to the hardening furnace and brought to the desired temperature, and held for a short period as in the case of tungsten steels.

HEAT-TREATING TEMPERATURES FOR HIGH-SPEED STEELS—DEGREES FAHRENHEIT

Basic Analysis	Forging			Annealing		Hardening		Tempering [3]
	Preheating	Forging Temperature [1]	Stop Forging at	Temp. Range	Brinell Hardness (Annealed)	Preheating [2]	High Heat	
Tungsten Types								
18-4-1	1400–1600	2000–2100	1700	1600–1650	217–241	1450–1600	2250–2350	1000–1150
18-4-2	1400–1600	2000–2150	1700	1600–1650	223–248	1450–1600	2300–2350	1000–1150
18-4-3¼	1450–1500	1950–2100	1800	1600–1650	228–255	1500–1600	2250–2300	1050–1100
18-4-1 + 4 Co	1400–1600	2050–2150	1700	1600–1650	223–248	1500–1600	2350–2400	1000–1150
18-4-2 + 8 Co	1400–1600	2100–2200	1700	1625–1675	223–248	1500–1600	2325–2375	1000–1150
22.5-1.5 + 12 Co	1400–1600	2100–2200	1800	1600–1650	235–255	1500–1600	2325–2375	1000–1150
14-4-2	1400–1600	2000–2100	1700	1600–1650	217–241	1450–1600	2200–2300	1000–1150
14-4-2 + 5 Co	1400–1600	2050–2150	1700	1600–1650	223–248	1500–1600	2325–2375	1000–1150
Molybdenum Types								
8-4-1 + 1.5 W	1300–1500	1900–2000	1650	1550–1600	200–228	1400–1500	2150–2250	950–1100
4-4-1.5 + 5 W	1300–1500	1950–2050	1650	1550–1600	217–241	1450–1550	2200–2300	1000–1150
8-4-2	1300–1500	1900–2000	1650	1550–1600	200–228	1400–1500	2150–2250	950–1100
8-4-1 + 2.5 Co	1300–1500	1900–2000	1650	1550–1600	217–241	1400–1500	2200–2250	950–1100
8-4-1-1.5 W + 4 Co	1300–1500	1900–2000	1650	1550–1600	217–241	1400–1500	2200–2250	950–1100
8-4-1 + 8 Co	1300–1500	1950–2100	1700	1550–1600	217–241	1450–1550	2200–2275	950–1100
9-4-4	1300–1500	1950–2050	1700	1550–1600	223–248	1400–1500	2175–2250	950–1100
6-4-1.5 + 6 W	1300–1500	1950–2000	1700	1550–1600		1550–1600	2300–2325	1050

1. These temperatures refer to re-forging semi-finished billets or bars and differ from steel mill practice.
2. When double preheats are used, the lower preheat may be at about 1,200 F., and the higher preheat up to 1,800 F.
3. A temperature of 1050 F. is most commonly used for tungsten-type steels.

Soaking is not desirable. In the case of the 8-4-1+2.5 Co analysis, it is best to keep the quenching temperature down, in the experience of one manufacturer, because deterioration in the structure begins at temperatures over 2,100 F.

QUENCHING

Tungsten Steels—Quenching can be done for the 18-4-1 analysis in still air, a dry air blast, oil, salt bath, lead bath or between water-cooled plates. When quenching in molten salt or lead, the temperature of the bath is usually 1,200 F., and the tools are allowed to remain in it from 5 to 10 min. until equalized at this temperature. They are then cooled in air. Lathe and planer tools can be quenched in an air blast, but milling cutters, reamers and drills are best quenched in oil maintained at 150 to 200 F.

Internal stresses resulting from hardening are somewhat proportional to the size of the tool. Usually it is not detrimental to small tools to cool them to room temperature before tempering. Large tools, however, should often be kept at 150 to 250 F. until they can be transferred to the tempering furnace. Tools cooled in an air blast do not resist tempering as much as those cooled in oil and can be tempered at slightly lower temperature.

One authority believes that there is more danger in tempering a tool before it has hardened sufficiently in the quench than a little laxity in not tempering the tool immediately. The operator should be sure that the tool is quenched below 200 F.

Molybdenum Steels — Quenching molybdenum steels in oil is preferred, but optional methods are a dry air blast or a hot salt bath.

TEMPERING

Tungsten Steels—All sizes of tungsten steel tools should be placed in a tempering furnace maintained at a comparatively low temperature and heated slowly and uniformly to the secondary hardness range, 1,000 to 1,150 F. Tempering above this range or below it to 800 F. will increase the toughness, as measured by the static torsion test, but will sacrifice the hardness.

Usually the tools are held at the desired temperature for two hours per inch of thickness. Some toolmakers increase the tempering time; others prefer a double tempering operation, which involves a second heating to 25 to 50 F. below the first tempering temperature, but still within the secondary hardness range. For both heatings the tools are held at temperature for at least one and one-half hours per inch of thickness. Cool in air.

Molybdenum Steels—Tools made from molybdenum steels should be removed from the quenching oil when they reach 200 F. and placed immediately in the tempering furnace. If allowed to cool to room temperature before tempering, cracks may develop if strains are set up in quenching and not relieved immediately. Pieces should be heated slowly to the tempering temperature best suited to the tool and the type of steel, and held there for at least 1½ hr. per inch of thickness. Cool in air. After drawing, the borax film (if present) can be removed by immersing the tools in a 20 per cent solution of acetic acid for about one hour at 150 F.

NITRIDING AND CYANIDING

Certain classes of tools are given a hard case after grinding to secure surface hardness. The standard nitriding treatment has not proved as satisfactory as the cyanide treatment because of the greater concentration of nitrides at the surface, thereby causing unusual brittleness. But tools used for machining abrasive materials such as bakelite may be given the standard nitriding treatment.

Fine-edged tools like taps and chasers are improved for certain classes of work by immersing in a molten bath composed of 50 per cent potassium cyanide and 50 per cent sodium cyanide maintained at 1,050 F. Such tools should first be hardened, tempered and ground, and then reheated slowly to a temperature of 1,000 F. before immersing in the bath. They should be held in the cyanide bath from five or ten minutes to as long as one hour, depending upon the nature of the tool and the results desired, and cooled slowly in air.

Tungsten Steels—Where equipment is available, it is good practice to preheat 18-4-1 in a separate furnace, bringing the material slowly to 1,400-1,500 F. and permitting it to soak. Then transfer to the forge heating furnace and heat more rapidly to 2,000-2,100 F. Do not hold unnecessarily long at this temperature to avoid excessive grain growth and decarburization. Heavy forging should be discontinued at 1,700 F. and the piece reheated.

To prevent strain distortion and cracks, bury small forgings in heat-retardant material such as hot ashes, lime, silocel or powdered mica. Large forgings are best placed in an electric furnace maintained at 1,500-1,600 F. Soak until all parts of the piece reach this temperature, close the furnace openings, shut off the heat, and allow the piece to cool slowly. Neither procedure is an anneal, which must follow according to the practice given under that subject.

Other tungsten high-speed steels are treated in much the same manner. The cobalt types require more care and are more difficult to forge. They are more prone to check or crack if forged at too low temperature or allowed to cool too rapidly. Difficulty has been experienced in forging 22-5-1.5+12 Co steel, which has an alloy content of 40 per cent.

MACHINING ALLOWANCE FOR MILL DECARBURIZATION

Diameter or Thickness	Remove from Surface
Up to and including ½ in.	1/64 (0.016)
½ to 2 in.	1/32 (0.032)
2 to 3 in.	1/16 (0.062)
3 to 4¾ in.	1/8 (0.125)
4¾ to 8 in.	3/16 (0.1875)

Note: Flat sections where the width is two or more times the thickness, only one-half the allowance shown on the above table is required on the width. The tolerance on the thickness should be the same as shown in the table.

Molybdenum Steels—To prevent decarburization, it is common practice to coat the steel with borax by either of two methods: (1) sprinkle with powdered borax or roll in a box of borax after preheating to 1,300-1,500 F., or (2) dip either cold or hot in a saturated solution of borax maintained at 180 F. The first method is messy and is harmful to some types of furnace refractories. Only a light coating should be applied. Recoat with borax prior to each reheating. The 4-4-1.5+5 W molybdenum type is said not to require a protective coating.

Molybdenum steels forge at lower temperatures and easier than the 18-4-1 tungsten type. Preheat slowly to 1,300–1,500 F. and then more rapidly to the forging range, which is 1,900–2,000 F. for the 8 Mo-4 Cr-1 V-1.5 W analysis. Pieces can be worked safely down to 1,650 F. for the same analysis. Forgings should preferably be cooled in heat-retardant material.

FORGING PRACTICE

In forging blanks for high-speed steel milling cutters and hobs, account must be taken of the greater resistance of such highly alloyed materials to plastic flow. Consequently, as the thickness and the diameter of the disk increases, the center structure is less affected in the upsetting operation and has a tendency to retain more or less of its original brittle nature. In general, high-speed forgings should be upset from a length of billet that should be at least twice the billet size. It is a matter of experience that when the thickness of a forging exceeds one-half the diameter, there is an increase in the chances of developing hammer bursts in the center during the rolling operation on flat dies.

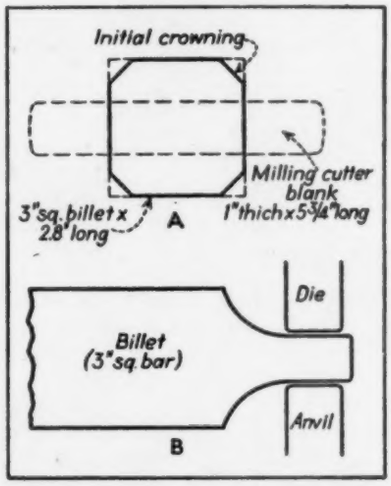
There is an advantage in finishing such forgings in shape dies so that the pressure is applied uniformly in the finishing operation. For this reason, cylindrical-shaped forgings with lengths 50 to 100 per cent of the diameter are preferably finished in dies. Lengths required do not often exceed the diameter. Such forgings are the most difficult to make; that is to obtain uniform carbide distribution throughout and a sound center structure. Common diameters run from 2½ to 5 in. in ¼ in. steps. The popular hob cutter sizes are 3 to 4 in., inclusive.

When a billet is forged with flat dies, the sawed surface may crack open if hit directly over the full surface. To avoid this, the billet is held at an angle, and "crowning" is done by hitting the billet on the corners and edges. This is continued until the pancake-like blank is produced. On difficult applications the billet is not sawed, but is heated and parted with a hack.

CUTTER BLANKS

Small cutter blanks are usually forged in one heat, but on some larger sizes reheating is necessary. In forging high-speed steel into round bars, it is better to draw the stock out square than to attempt to round it up on flat dies, as there is danger of hammer bursts in the center. The rounding up of the bars can be better accomplished with the use of curved or swaging dies rather than flat dies.

Forging down a bar to a smaller thickness is done in steps from the ends. The center does not flow equally with top and bottom surfaces when the entire area is struck at once, thereby inducing cracks or "brusts" in the center. It is necessary to forge with sufficient weight of blow in relation to the bearing of the dies to make the steel move in the center. Correct practice is to take "small bites" with the hammer. Jobbing forge shops usually provide ⅛ in. finishing allowance, to permit removal of carburized or decarburized skin.



High-speed steel is so dense, that the billet at A *must be crowned by striking on the corners. A blow heavy enough to move the entire top surface might cause cracking. Forging down a bar as at* B *is done in small steps to make the material move in the center*

AMERICAN MACHINIST REFERENCE BOOK SHEET

Hardness Conversion Chart For Hardened Steels

COURTESY OF THE RIEHLE TESTING MACHINE DIVISION, AMERICAN MACHINE AND METALS, INC.

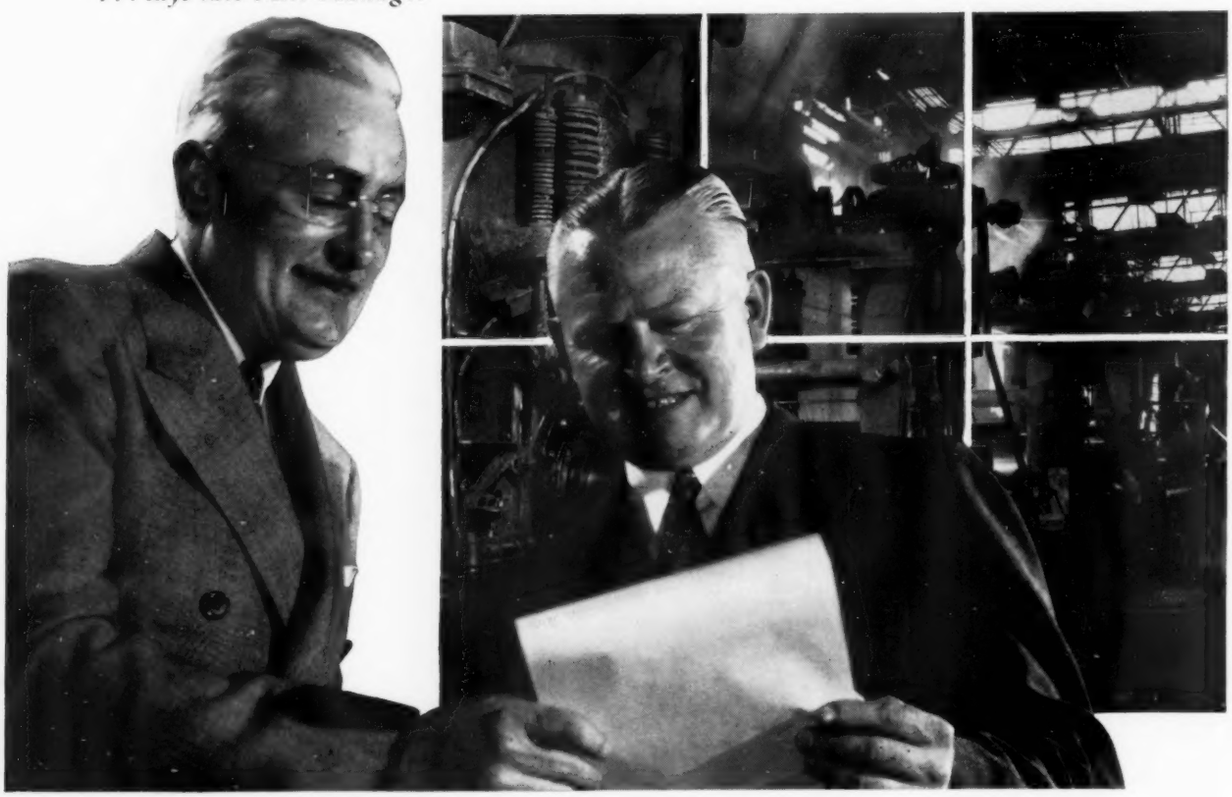
Vickers Pyramid Number 50-Kg. Load	Rockwell Hardness					Scleroscope Hardness	Monotron Load Scale Value (9 Divisions)	Brinell Hardness 10 mm. Ball, 3000-Kg. Load				Approximate Tensile Strength of Steel	Vickers Pyramid Number 50-Kg. Load.
	C-Scale-150 kg. Brale Penetrator	A-Scale-60 kg. Brale Penetrator	Superficial (Wilson Chart No. 38)					Hultgran Ball VPN 940		Steel Ball VPN 900			
			15-N Scale	30-N Scale	45-N Scale			Hardness Number	Diameter in mm.	Hardness Number	Diameter in mm.		
VPN	RC	RA	15-N	30-N	45-N	Scl.	Mon.	BHN	mm.	BHN	mm.	T.S.x10³	VPN
210	16.7	57 6	67.3	39.3	16.0	33.5	26.6	210	4.17	210	4.17	102	210
220	18.4	58.7	68.3	40.7	17.8	35.2	28.1	219	4.08	220	4.07	106	220
230	20.1	59 8	69.3	42.1	19.6	36.7	29.6	226	4.03	230	3.99	109	230
240	21.7	60.7	70.3	43.5	21.3	37.9	31.0	235	3.95	240	3.91	113	240
250	23.3	61.6	71.2	44.8	23.4	39.1	32.3	244	3.88	250	3.84	118	250
260	24.8	62.5	72.1	46.1	25.1	40.3	33.7	252	3.82	260	3.76	123	260
270	26.2	63.2	72.9	47.3	26.8	41.5	35.0	261	3.76	269	3.70	127	270
280	27.6	63.9	73.6	48.4	28.4	42.8	36.3	270	3.69	279	3.64	131	280
290	28.8	64.6	74.3	49.5	30.0	44.0	37.6	280	3.63	288	3.58	136	290
300	30.0	65.3	75.0	50.6	31.4	45.2	38.9	289	3.58	297	3.53	140	300
310	31.2	65.9	75.7	51.7	32.8	46.4	40.1	298	3.52	306	3.48	145	310
320	32.4	66.5	76.4	52.8	34.2	47.6	41.3	307	3.47	315	3.43	150	320
330	33.6	67.1	77.0	53.7	35.6	48.8	42.5	316	3.42	324	3.38	154	330
340	34.7	67.7	77.6	54.7	36.9	49.9	43.7	326	3.37	333	3.34	158	340
350	35.8	68.2	78.2	55.6	38.2	50.9	44.8	335	3.33	341	3.30	162	350
360	36.9	68.7	78.8	56.6	39.5	51.9	45.9	345	3.28	349	3.26	168	360
370	38.0	69.3	79.3	57.5	40.7	52.9	47.0	355	3.24	358	3.22	173	370
380	39.0	69.8	79.8	58.3	41.8	53.9	48.0	365	3.19	368	3.18	178	380
390	39.9	70.3	80.3	59.2	42.9	54.9	49.1	375	3.15	377	3.14	183	390
400	40.8	70.8	80.8	60.0	44.0	55.8	50.1	385	3.11	385	3.11	188	400
410	41.7	71.3	81.3	60.8	45.1	56.7	51.2	395	3.07	393	3.08	194	410
420	42.6	71.8	81.7	61.6	46.1	57.6	52.3	405	3.04	401	3.05	200	420
430	43.4	72.3	82.1	62.5	47.1	58.5	53.3	414	3.00	410	3.02	205	430
440	44.2	72.7	82.5	63.3	48.1	59.4	54.3	422	2.97	418	2.99	209	440
450	45.0	73.2	82.9	64.0	49.1	60.3	55.3	429	2.95	426	2.96	214	450
460	45.7	73.6	83.3	64.8	50.0	61.2	56.3	437	2.92	433	2.94	219	460
470	46.4	74.0	83.7	65.5	50.9	62.0	57.4	445	2.90	441	2.91	223	470
480	47.1	74.4	84.10	66.1	51.8	62.8	58.4	453	2.87	449	2.89	228	480
490	47.8	74.8	84.43	66.7	52.6	63.6	59.5	461	2.85	457	2.86	233	490
500	48.5	75.2	84.77	67.2	53.4	64.5	60.6	469	2.82	465	2.84	238	500
510	49.2	75.5	85.10	67.8	54 1	65.4	61.7	478	2.80	473	2.81	244	510
520	49.9	75.8	85.43	68.3	54.8	66.3	62.8	487	2.77	481	2.79	250	520
530	50.5	76.1	85.77	68.8	55.5	67.1	63.8	496	2.75	488	2.77	255	530
540	51.1	76.4	86.10	69.4	56.2	68.0	64.8	505	2.73	495	2.75	260	540
550	51.7	76.7	86.36	69.9	56.9	68.9	65.8	514	2.70	503	2.73	265	550
560	52.3	77.0	86.62	70.4	57.6	69.7	66.8	522	2.68	510	2.71	270	560
570	52.9	77.3	86.88	70.9	58.3	70.5	67.8	530	2.66	517	2.69	275	570
580	53.5	77.6	87.14	71.4	58.9	71.3	68.8	538	2.64	523	2.68	280	580
590	54.1	77.9	87.40	71.9	59.6	72.1	69.8	546	2.62	529	2.66	285	590
600	54.7	78.2	87.65	72.4	60.2	72.9	70.8	553	2.60	534	2.65	290	600
610	55.2	78.5	87.90	72.9	60.9	73.7	71.9	560	2.59	540	2.64	295	610
620	55.7	78.8	88.15	73.4	61.5	74.5	73.0	567	2.57	546	2.62	300	620
630	56.2	79.1	88.40	73.9	62.1	75.3	74.0	574	2.56	552	2.61	305	630
640	56.7	79.4	88.65	74.4	62.7	76.1	75.0	581	2.54	558	2.59	310	640
650	57.2	79.65	88.90	74.9	63.3	76.9	76.0	587	2.53	564	2.58	315	650

Continued on page 103

NOTE: This chart was compiled from data secured by H. Scott and T. H. Gray, Westinghouse Electric & Manufacturing Company

"Look at this improved production record with Gulf's higher quality Lubricants"

. . . says this Mill Manager



"We've improved both quality and quantity of production since we adopted the Gulf Engineer's Recommendations"

"THIS production record tells a real story," says this mill manager. "Since we adopted Gulf's higher quality lubricants, we have not only increased the efficiency of our machinery, but have pared down our maintenance costs. *The few cents more we invest in these better oils are returning us a handsome profit.*"

Your machinery may be operating in a fairly satisfactory manner with "run-of-mine" lubricants in service. But if you are not entirely satisfied with your plant production — from the standpoint of quality, quantity, or costs — we suggest that you give special attention to your lubrication.

Ask the Gulf engineer to recommend improved lubrication practice in your plant. He consults tactfully with plant men, and his one aim is to help you increase efficiency and reduce your operating costs through the proper application of lubricants exactly suited to each machine and moving part. You can rely upon his recommendations. They are based on wide experience with the lubrication of machinery similar to yours. The Gulf line includes more than 400 quality oils and greases. These better lubricants are readily available to you through more than 1100 warehouses in 30 states from Maine to Texas. Write or 'phone your nearest distributing point today. . . Gulf Oil Corporation, Gulf Refining Company, Gulf Building, Pittsburgh, Pa.

GULF INDUSTRIAL LUBRICATION

A COMPLETE LINE OF MORE THAN 400 OILS AND GREASES FOR INDUSTRY

Hardness Conversion Chart For Hardened Steels

Continued from page 101

Vickers Pyramid Number 50-Kg. Load	Rockwell Hardness					Scleroscope Hardness	Monotron Load Scale Value (9 Divisions)	Brinell Hardness 10 mm. Ball, 3000-Kg. Load				Approximate Tensile Strength of Steel	Vickers Pyramid Number 50-Kg. Load.
	C-Scale-150 kg. Brale Penetrator	A-Scale-60 kg. Brale Penetrator	Superficial (Wilson Chart No. 38)					Hultgran Ball VPN 940		Steel Ball VPN 900			
			15-N Scale	30-N Scale	45-N Scale			Hardness Number	Diameter in mm.	Hardness Number	Diameter in mm.		
VPN	RC	RA	15-N	30-N	45-N	Scl.	Mon.	BHN	mm.	BHN	mm.	T.S.x10³	VPN
660	57.7	79.90	89.10	75.4	63.9	77.6	77.1	593	2.52	570	2.57	320	660
670	58.2	80.20	89.30	75.9	64.5	78.3	78.2	599	2.51	575	2.56	.....	670
680	58.7	80.50	89.50	76.4	65.1	79.0	79.2	604	2.49	580	2.55	.....	680
690	59.2	80.80	89.70	76.9	65.7	79.8	80.2	609	2.48	585	2.53	.....	690
700	59.7	81.10	89.90	77.3	66.2	80.6	81.3	614	2.47	590	2.52	.....	700
710	60.2	81.35	90.10	77.7	66.8	81.3	82.4						710
720	60.7	81.60	90.30	78.1	67.3	82.0	83.5						720
730	61.2	81.85	90.50	78.5	67.8	82.7	84.5						730
740	61.6	82.10	90.70	78.9	68.3	83.5	85.5						740
750	62.0	82.35	90.90	79.3	68.8	84.3	86.5						750
760	62.5	82.60	91.10	79.7	69.3	85.0	87.5						760
770	63.0	82.85	91.30	80.1	69.8	85.7	88.5						770
780	63.4	83.05	91.45	80.4	70.3	86.4	89.5						780
790	63.8	83.25	91.60	80.7	70.7	87.1	90.5						790
800	64.2	83.45	91.75	81.00	71.1	87.8	91.5						800
810	64.6	83.65	91.90	81.34	71.5	88.5	92.5						810
820	64.9	83.85	92.05	81.67	71.9	89.2	93.6						820
830	65.2	84.05	92.19	82.00	72.3	89.9	94.7						830
840	65.5	84.22	92.32	82.28	72.7	90.6	95.7						840
850	65.8	84.39	92.45	82.56	73.1	91.3	96.8						850
860	66.2	84.55	92.58	82.83	73.5	92.0	97.9						860
870	66.5	84.71	92.70	83.10	73.8	92.7	99.0						870
880	66.8	84.87	92.82	83.34	74.1	93.4	100.0						880
890	67.1	85.02	92.94	83.58	74.4	94.0	101.0						890
900	67.4	85.17	93.06	83.82	74.7	94.7	102.0						900
910	67.7	85.32	93.17	84.06	75.0	95.4	103.1						910
920	68.0	85.46	93.28	84.28	75.3	96.0	104.2						920
930	68.25	85.60	93.39	84.50	75.6	96.7	105.3						930
940	68.50	85.74	93.50	84.73	75.9	97.4	106.4						940
950	68.75	85.87	93.60	84.95	76.2	98.0	107.5						950
960	69.0	86.00	93.70	85.15	76.5	98.7	108.6						960
970	69.25	86.13	93.79	85.35	76.8	99.4	109.7						970
980	69.50	86.25	93.87	85.55	77.10	100.0	110.8						980
990	69.70	86.36	93.95	85.70	77.25	100.7	111.8						990
1000	69.90	86.46	94.03	85.85	77.40	101.3	112.8						1000
1010	70.10	86.55	94.11	86.00	77.55	101.9	113.8						1010
1020	70.30	86.64	94.18	86.10	77.70	102.5	114.9						1020
1030	70.50	86.73	94.25	86.20	77.85	103.0	116 0						1030
1040	70.70	86.81	94.31	86.30	76.00	103.5	117.0						1040
1050	70.90	86.88	94.36	86.40	77.10	104.0	118.0						1050

THICKNESS OF STOCK REQUIRED FOR ACCURACY (TEN TIMES THE DEPTH OF IMPRESSION IN INCHES.)

VPN	VPN 10 kg.	VPN 50 kg.	Rc	15-N	45-N	BHN
200	.017	.038	.072	.015	.040	.186
300	.014	.031	.059	.012	.032	.135
400	.012	.027	.050	.009	.026	.098
500	.011	.024	.044	.007	.022	.080
600	.010	.022	.038	.006	.018	.068
700	.0092	.020	.033	.005	.016	
800	.0086	.019	.030	.004	.013	
900	.0081	.018	.027	.003	.012	
1000	.0026	.017	.025	.003	.010	

Monotron tests at all hardnesses can be made on 0.018-in. stock. Scleroscope numbers vary with size, relations given are for 1-in. pieces.

In operating any testing machine, follow manufacturer's instructions and check frequently against test blocks. Major causes of discrepancy: (a) decarburized skin, (b) specimens too thin, (c) off-standard indenters, (d) inaccuracy of machine.

Above conversions are for steel, irrespective of composition and structure, up to its maximum hardness, and for any other material having about 30,000,000 psi. elastic modulus, uniform in depth to bottom of impression. (An exception is that Rockwell test values for shallow hardened steel may be 1 or 2 points higher than by conversion from VPN. For sintered carbides (VPN 900 to 1700) with much higher modulus the relations between VPN and Rc may be computed from $VPN = \frac{2.445 \times 10^6}{(B-Rc)^2}$ wherein constant B is 118 for carbide (120 for steel).

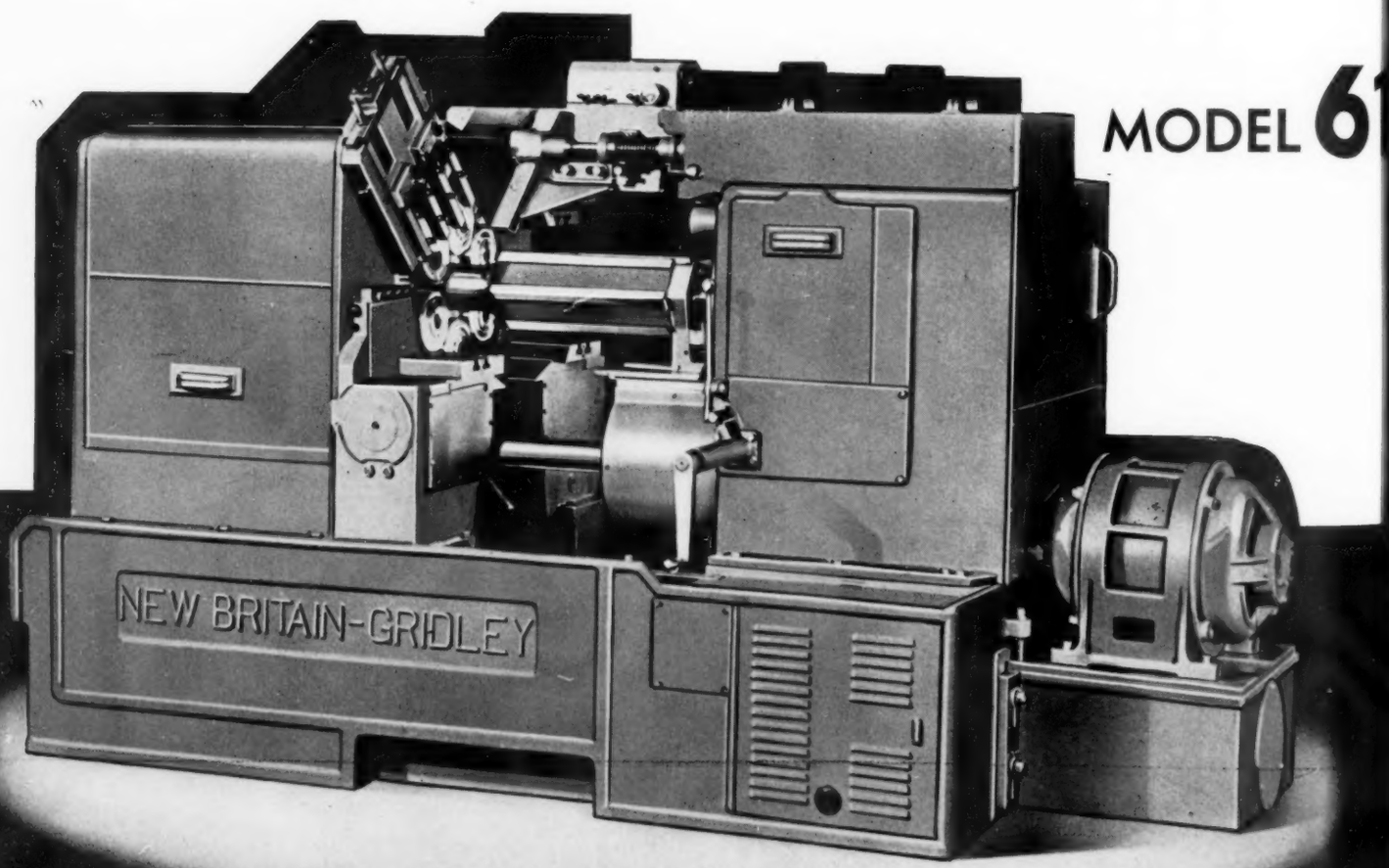
DEPENDABILITY

THE line of NEW BRITAIN Automatics has been engineered and developed with the paramount objective of retaining initial accuracy throughout continuous production on the toughest jobs, at the fastest speeds, and heaviest feeds.

Exclusive Features, incorporated for Permanent Accuracy, plus "Profit Engineering" for every tool setup, assure dependable performance at the maximum efficiency of modern cutting tools.

NEW BRITAIN-GRIDLEY

MACHINE DIVISION • THE NEW BRITAIN MACHINE CO.
NEW BRITAIN, CONNECTICUT



MODEL 61

A complete line of Screw Machines — Four and Six Spindles to 2¼" Capacity
Also a complete line of Chuckers — Four, Six and Eight Spindles to 10⅜" Capacity

A Throttle on Business

THEY SAY that death and taxes are always with us. We can't do much about death, but surely we can do something about taxes.

If current happenings are any criterion, people are in a fit mood for a tax explosion which will leave taxes considerably deflated from the present inflated level. It is time to change the tune which for some years has been dinned into our ears by the politicians, "We Need More Money."

In New York a few weeks ago Governor Lehman blandly recommended a sizable hiking of an already hefty State income tax to help balance the budget. It wasn't long before a mighty roar arose from taxpayers. Whereupon the proposal was tossed in the ash can by leading legislators.

Indicative of an aroused public consciousness of public spending was the hearing on the New York State budget held in Albany on Lincoln's birthday. It took a huge armory to hold the 6500 citizens who came from all parts of the State by automobile and by special train.

Fortunately all classes of citizens are becoming aware of the handicap to industry as well as to the individual of an abnormally heavy tax burden. Perhaps the explanation is that in the past seven years they have watched the national debt rise $19,000,000,000, yet today there still are close to 10,000,000 people unemployed. Lavish government spending evidently has worked no magic in finding jobs for people willing to work.

And that gets us to the crucial point. Business men have been raised on the old-fashioned belief that disaster awaits him who gaily goes along paying out more than he takes in. That applies alike to an individual, a company or a government. If an individual thumbs his nose at that belief, sooner or later he lands in a bankruptcy court. If a business man cannot prevent his company from landing in that same court, he is ousted for incompetence. Only in government—local, State and federal—have the people voted confidence in leaders who persist in casting orthodox financial policies to the wind.

But at last people are becoming genuinely worried over the government's finances. They are beginning to see that heavy taxes throttle business just as they keep the individual from spending more of his income for the goods produced by industry.

Even organized labor sees the danger. Ten top-flight leaders of the American Federation of Labor had this to say in a recent signed statement:

"One of the great drags upon industry during the past seven years has been the burden of taxation that has been imposed upon big and little business . . . The effect of this tremendous drain on industry is doubly disastrous to labor and employment. Every dollar paid in taxes by industry is a dollar that cannot be used for payrolls, for development or for expansion."

The only way to halt prodigal spending is for every person to constitute himself a committee of one to work toward that end. Make your voice felt in legislative halls by writing to your elected representatives. Make your vote count by casting your ballot for men with sound fiscal ideas. Give your support to organizations pledged to bring government spending back within reasonable bounds.

Burnham Finney

GAGING BUSINESS

Metal-working activity continues accelerated pace under impetus of well-distributed buying. Machine tool orders drop slightly, but operations remain at 93 per cent

A generous outpouring of national defense contracts, plus brisk demands from domestic industries and from foreign customers, has kept metal-working plant operations on an even keel. Most companies continue to work extra shifts and have the most employees on their payroll in years, not excepting 1937. The Army and Navy alone have awarded to metal-working manufacturers $9,450,424 of business the past two weeks, including $2,614,735 of educational orders for the Army.

MACHINE TOOLS—Though some companies report sales continuing at abnormally high levels, others say that bookings are off considerably from the January volume and particularly from the fourth quarter average. In the domestic market Chrysler and General Motors are understood to have sizable replacement and modernization programs planned. Nash already has ordered equipment for production of a new car. In the Chicago area the smaller and medium-sized shops are buying more machinery, while in certain other parts of the country buying programs have been temporarily shelved after all the preparatory work had been done. The aircraft industry still gives the machine tool industry its biggest lift in orders, with aircraft engine and precision parts makers pressing for speedier deliveries. The French Commission signed contracts the past week with a number of machine tool builders for its 1940 requirements. The British have contracted for some machinery for aircraft building, but much of its buying is still being deferred. Japan is trying desperately to get machine tools in the United States, but is meeting with the problem of long delayed deliveries as well as with the unwillingness of American companies to extend credit. An indifference to Russian business is expressed by many machine tool builders who do not intend to solicit further orders after present contracts are completed. Machinery has been ordered in this country by Canadian firms which are to manufacture an anti-tank gun for the British. Parts production will be sublet to smaller companies in Canada. Machine tool operations are continuing at the 93 per cent level which prevailed in both December and January.

AIRCRAFT—Airplane production is limited only by the number of high horsepower motors and the volume of precision instruments which can be turned out. Engine output will be stepped up considerably in the next 60 days as Pratt & Whitney Aircraft, Wright Aeronautical and Allison Division of General Motors complete plant expansion programs. Backlogs of airplane makers are tremendous. Douglas alone has $90,000,000 of orders, Lockheed $66,000,000 and North American $50,000,000.

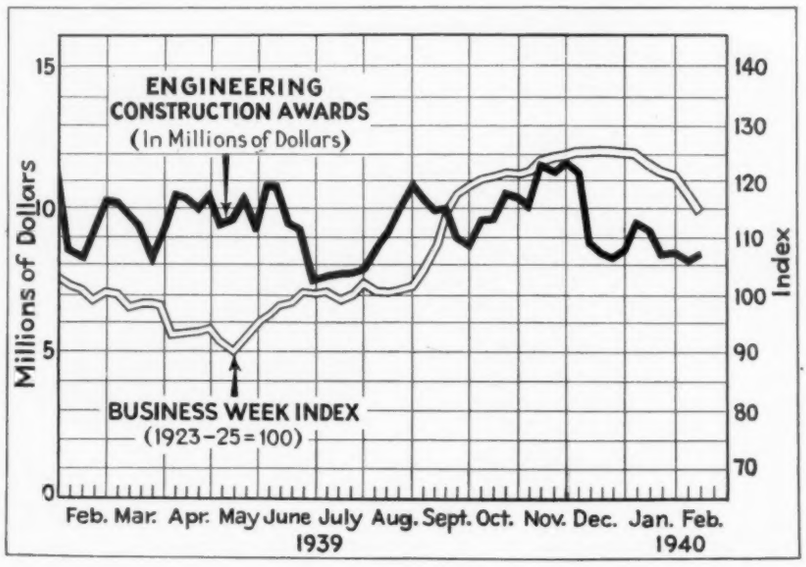
GEARS—Gear sales for January were 35.1 per cent ahead of the same month a year ago and 10.8 per cent better than in December, according to the American Gear Mfrs. Assn.

FARM IMPLEMENTS & TRACTORS—Manufacturers are operating at better levels than a year ago, the backbone of current production being tractors. Increases in small tractor sales are anticipated this year. A prominent tractor builder will announce a new line of implements in March to go with its small tractor.

RAILROAD EQUIPMENT—Freight cars on order in January were the largest at any time since 1926, indicating plenty of work ahead for most equipment builders. The Rock Island has been authorized to purchase 1,000 box cars and 10 diesel-electric switchers. Otherwise, new business is meager. Canadian Railway equipment companies, busy on orders placed by the Government last quarter, are receiving inquiries for additional freight cars.

STEEL—Ingot output last week was 68.8 per cent, compared with 84.8 per cent a month ago. A further slide is expected. Not too much business can be looked for from automobile companies, many of which bought their entire 1940 model season's requirements last fall. Chevrolet will need material for about 150,000 to 200,000 cars and Buick for 50,000 to complete their runs.

SHIPBUILDING—Though private yards and navy yards are going great guns, with operations the broadest in years, a mistaken impression has gone round that all the industry's facilities are occupied. Actually, 83 active ways are still available, 62 of them on the Atlantic coast, capable of producing one million tons of shipping a year. This capacity could be increased 50 per cent by conditioning 37 inactive ways now partially dismantled. Four cargo ships for the Maritime Commission, awarded to Consolidated Steel Corp. on the West Coast, will be constructed at the Craig Shipyards, Long Beach, Calif.



New Educational Orders Total Over Two Million

WASHINGTON — Army educational orders totaling $2,614,735 have been announced by Assistant Secretary of War Louis Johnson. Forging shell and related items have been placed with the following companies: Colorado Fuel & Iron $251,674, Taylor-Wharton Iron & Steel Co. $209,217, Chrysler Corp. $67,732, Pressed Steel Car Co. $119,832, Tennessee Coal, Iron & Railroad $130,350, Pittsburgh Forgings Co. $36,364, Chevrolet $36,127.

Contracts for machining shell and related items have been awarded as follows: Minneapolis-Moline Power Implement Co. $139,628, Omaha Steel Works $161,658, Armstrong Cork Co. $85,165, J. B. Beard Corp. $108,770, Continental Gin Co. $72,521, Chrysler Corp. $110,616, Darling Valve & Mfg. Co. $58,902, General Railway Signal Co. $102,560, Kingston Products Corp. $44,372, Murray Co. $91,206, New York Air Brake Co. $79,552, Robbins & Myers, Inc., $85,170, Stockham Pipe Fittings Co. $69,957, U. S. Machine Corp. $38,055, Wheland Co. $66,758, Chevrolet, $100,850.

Duraloy Co. will make centrifugal castings and related items valued at $148,920 and Eastman Kodak Co. telescopes and related items valued at $34,566 under the educational orders program.

N.A.M. Honors Engineers For Industrial Achievements

NEW YORK—The country's outstanding inventors and research workers are being honored this month as "Modern Pioneers on the Frontier of Industry" in a series of dinner meetings which will reach a climax in New York, Feb. 27. At the final meeting the National Association of Manufacturers, which is sponsoring the nation-wide program, will present awards to the 19 men who have contributed most to new products, new industries and new jobs during the last quarter century.

Edwin R. Fellows, president Fellows Gear Shaper Co., and Thure Larsson, Norton Co., were cited for outstanding achievements at the Boston area meeting. Alexander Littlejohn Feild, vice-president Rustless Iron & Steel Corp., was one of the men honored at the Baltimore meeting. At the Chicago area dinner awards were made to Walter Geist, vice-president, Ray C. Newhouse, engineer, and Dr. William M. White, engineer, Allis-Chalmers Mfg. Co.; Julius Benjamin Wantz, vice-president General Electric X-Ray Corp.; and L. R. Smith, chairman of board A. O. Smith Corp.

William F. Groene, vice-president and chief engineer R. K. LeBlond Machine Tool Co.; E. A. Muller, president King Machine Tool Co.; William R. Chapin, manager of research E. C. Atkins & Co.; and John B. Tytus, vice-president American Rolling Mill Co., were cited for honors at the Cincinnati area meeting.

Modern Pioneers especially honored at the Cleveland meeting included Tracy V. Buckwalter, vice-president Timken Roller Bearing Co. for outstanding achievements; Joseph Victor Emmons, Cleveland Twist Drill Co.; John C. Lincoln, chairman of board, and James F. Lincoln, president, Lincoln Electric Co.; John K. Hodnette and Samuel B. Kraut, Westinghouse Electric & Mfg. Co.; Marvin Pipkin, General Electric Co.; Rex D. O. McDill, president Inspection Machinery

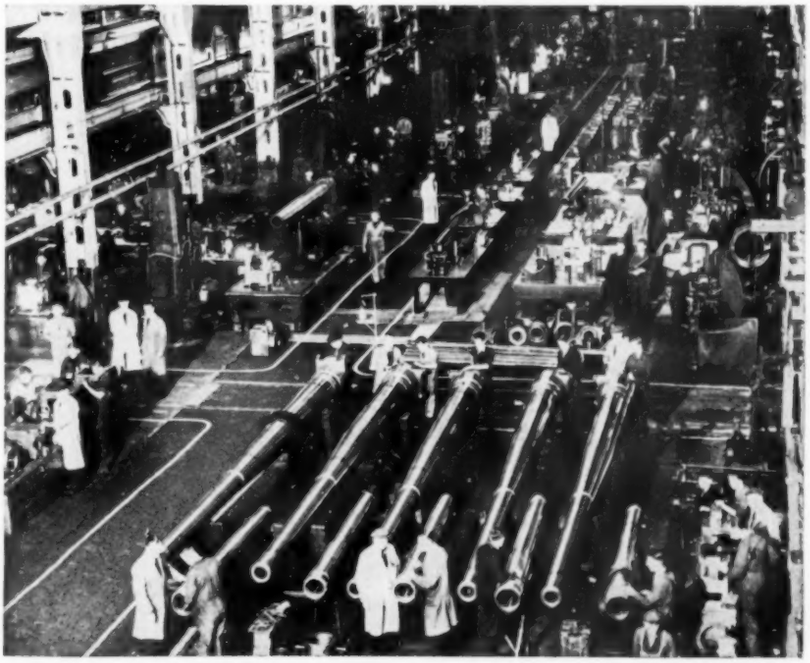
Japan Warns Industry Against China Enterprises

TOKYO—A warning against planning machinery and other heavy industrial enterprises in Manchukuo and China is sounded by Koshiro Shiba, chairman of the board of Mitsubishi Heavy Industry Corp. Mass production of automobiles, aircraft and machine tools are dependent on scores of subcontracting shops nearby which today are non-existent in Manchuria and China. There is also lack of communications, coal, electric power and water.

New corporations continue to spring up in Manchukuo and China, but they are unable to procure construction materials and equipment. Japan cannot supply them, and there is no exchange with which to import the necessary machinery from other countries. Yoshisuke Aikawa, president of the 100-million-yen Manchu Automobile Mfg. Co., Ltd., who for the past two years vainly tried to obtain U. S. machinery on credit, recently entrained for Europe to see what assistance he can get there. Soji Yamamoto, his managing director, has gone to Italy after an unsuccessful stay in the United States.

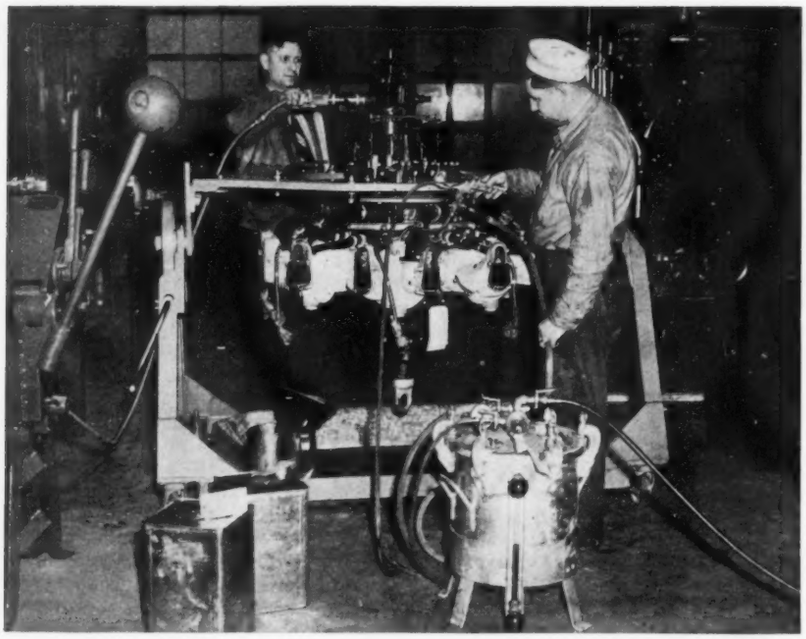
A leading U. S. company is said to be interested in Japanese proposals to invest equipment in a steel rolling mill in Manchukuo. United Engineering & Foundry Co. already has organized the Shibaura-United Engineering Co. in cooperation with the local International General Electric operating unit. Another unproductive outfit, the Manchuria Aircraft Corp., has bought control of the Showa Aircraft Co. of Japan and has started to haul the latter's equipment to Mukden.

Imports of machine tools and machinery parts into Japan for the three months of the European war dropped below the pre-war level because of the crippling effect of the Allied blockade on German exports. Japanese importers cancelled orders due to prohibitive marine insurance rates and placed them with U. S. manufacturers. The new business will not be reflected in U. S. export statistics before March or April or perhaps later.



British Combine

Spring Fever?—*Feverish indeed is the activity in England's huge naval gun factories, as this general view of one parts-jammed bay indicates. Does this mean large-scale offensives in the spring, or merely a tighter strangle-hold on Germany's economic life-line spanning the seas? Maybe the British know*



Rudy Arnold

Preserves—*The U. S. Coast Guard has adopted a preserving technique, developed by one of its own men, for protecting aircraft engines from rust during storage. A small compressed-air motor turns over the engine, while the protective coating of oil is applied to every part with ordinary paint-spray equipment*

MASON BRITTON HONORED

NEW YORK—Mason Britton, vice-chairman of the McGraw-Hill Publishing Co., was presented with a silver medal "in recognition of his distinguished services to advertising" at the annual advertising awards dinner for 1939 in New York Feb. 15. The awards, founded by Edward Bok, were administered by the Harvard School of Business Administration from 1924 to 1930.

Since 1935 they have been conducted under the sponsorship of *Advertising and Selling*. For many years Mr. Britton was actively in charge of AMERICAN MACHINIST.

MASON BRITTON

Co.; and Dr. Walther Mathesius, vice-president U. S. Steel Corp. Frank Conrad, assistant chief engineer, Westinghouse Electric & Mfg. Co., received an award for outstanding achievements.

At the Hartford area dinner the honored inventors and research men included Edward P. Bullard, Jr., president, and Thomas E. Dunn, works manager, Bullard Co.; Albert F. Breitenstein, works manager and chief engineer Geometric Tool Co.; John Cargill Shaw, Pratt & Whitney Division Niles-Bement-Pond Co., Fernley H. Banbury, Farrell-Birmingham Co., Inc., for outstanding achievements; and Frederick G. Hughes, New Departure Div. of General Motors Corp.

Those honored in the Detroit area include Carl Breer, director and executive engineer, Chrysler Corp.; D. J. Campbell, president Campbell, Wyant & Cannon Foundry Co.; Kirke W. Conner, president and general manager Micromatic Hone Corp.; Louis A. Cornelius, president Wolverine Brass Works; A. J. Fisher, General Motors Corp.; and Henry W. Ford, Ford Co.

Frederick M. Becket, Union Carbide & Carbon Corp., William D. Coolidge, General Electric Company, and George O. Crume, Jr., Carbide and Carbon Chemicals Corp. were cited in the New York area for outstanding achievements. Others honored include Leo Baekeland, Bakelite Corp.; Irving Langmuir and Willis R. Whitney, General Electric Co.; and A. W. Machlet, president, American aGs Furnace Co.

A joint award for outstanding achievements was made in the Rochester area to James F. Gleason, president and general manager, and Earnest Wildhaber, engineer, Gleason Works. Others to be honored were Edward Bausch and Wilbur B. Payton, Bausch & Lomb Optical Co.; and R. R. Ridgeway, Norton Co.

In the St. Louis area awards were made to Burns Dick, and Hans Weichsel of the Wagner Electric Co.; and to Edwin S. Pillsbury, president, Century Electric Co.

U. S. Government Contracts Awarded to Metal-Working Firms

(Machine Tool Awards on Page 104f)

Contractor	Gov't. Agency	Commodity	Amount
Camden Forge Co., Camden, N. J.	Navy	Roller tracks	$384,900
American Bridge Co., Gary, Ind.	TVA	Lock gates	248,430
Chase Brass & Copper Co., Waterbury, Conn.	Ordnance	Cartridge cups	76,360
Mueller Brass Co., Port Huron, Mich.	Ordnance	Brass forgings	107,550
Cooper Bessemer Corp., Grove City, Pa.	Navy	Diesel engine	36,731
American Bosch Corp., Springfield, Mass.	Navy	Diesel parts	32,150
Northwest Engineering Co., Green Bay, Wis.	Panama Canal	Power shovels	57,465
Thew Shovel Co., Lorain, Ohio.	Panama Canal	Power shovels	59,400
T. W. & C. B. Sheridan Co., New York, N. Y.	GPO	Covering machine	29,038
Woodward Governor Co., Rockford, Ill.	Interior	Governors	44,450
Snow & Petrelli Mfg. Co., New Haven, Conn.	Navy	Diesel parts	43,998
Heyl & Patterson, Inc., Pittsburgh, Pa.	Maritime Comm.	Gantry cranes	83,110
Western Electric Co., Kearny, N. J.	Coast Guard	Radio equipment	19,701
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.	QMC; Air Corps	Ranges, lamps	81,710
Mercury Mfg. Co., Chicago, Ill.	GPO	Fork trucks	19,350
Harley-Davidson Motor Co., Milwaukee, Wis.	QMC	Motorcycles	300,053
Indian Motocycle Co., Springfield, Mass.	QMC	Motorcycles	580,083
Union Boiler & Mfg. Co., Lebanon, Pa.	Coast Guard	Buoys	37,450
Seth Thomas Clocks, Thomaston, Conn.	Ordnance	Fuze parts	36,825
Westclox Div., General Time Instruments Corp., LaSalle, Ill.	Ordnance	Fuze parts	46,365
Ingersoll-Rand Co., Painted Post, N. Y.	Panama Canal	Compressors, grinders	36,295
Caterpillar Tractor Co., Peoria, Ill.	Panama Canal	Tractors	76,304
Worthington Pump & Machinery Corp., Harrison, N. J.	TVA	Air compressors	33,990
Quaker City Gear Works, Philadelphia, Pa.	Ordnance	Gears	15,242
Harnischfeger Corp., Milwaukee, Wis.	Ordnance	Bridge crane	29,710
Buffalo Forge Co., Buffalo, N. Y.	Navy	Ventilation equipment	39,751
Walworth Co., Greensburg, Pa.	Navy	Valves	26,426
Hayes Industries, Inc., Jackson, Mich.	Air Corps	Wheel assemblies	34,450
Pump Engineering Service Corp., Cleveland, Ohio	Air Corps	Fuel pumps	23,400

INSIDE DETROIT

By Rupert Le Grand
DETROIT EDITOR

Better feeling between General Motors and unions emerges from N.L.R.B. hearings on elections in 58 plants. Predictions are there will be no strike.

DETROIT—Contrary to the popular notion that "G.M. is next" as a UAW-CIO strike target after the forthcoming NLRB elections in 58 plants to determine which union shall represent the employees, subsequent negotiations over wages, seniority and grievance procedure are expected to proceed along peaceful lines. Spokesmen for the corporation and the union agree with this prediction.

UAW-CIO will probably be certified as the bargaining agency for all or most of the production employees of the 58 plants concerned. From recently concluded NLRB hearings over these elections, certain facts pointing to a better feeling have emerged: (1) The corporation did not obstruct the hearings by introducing voluminous testimony, (2) instead it signed a stipulation with the unions covering its position relative to how elections should be conducted, how negotiations should proceed prior to elections, and an appeal system for bargaining when no satisfactory agreement can be reached, (3) the corporation will set up convenient voting booths on its property and will not deduct pay for time lost for voting, (4) the union (UAW-CIO) agreed not to interrupt production unnecessarily during elections, and (5) UAW-CIO agreed to exclude nine of the 67 plants in which elections had originally been asked.

The stipulation signed by G.M. and the four unions—AFL-UAW, CIO-UAW, pattern makers (AFL) and die sinkers (AFL) states "the appropriate bargaining unit in connection with collective bargaining in General Motors Corporation is the plant or group of related buildings or plants operating under a common local resident manager in the same local community, producing similar or related products, or craft subdivisions within each plant as may be selected by the employees therein." Pattern makers and die sinkers will have an opportunity to vote for their respective AFL craft unions, for the CIO-UAW, or neither.

Sales Rebound After February Low

Car and truck production in March will rebound from the February low and will be on a par with the rate of assembly that prevailed in January. Signs of an upward trend were becoming apparent during the middle of this month. From a closer view, it is now apparent that output during the first quarter will closely approximate an earlier estimate of 1,300,000 units, U. S. and Canada.

Assemblies were cut back in February because of the usual winter lull coupled with bad weather, and because field stocks of most producers had reached a normal figure. But the temporary 20 per cent decline from the record output for January—465,000 units—caused fears to be expressed in certain quarters over the outlook for automobiles and steel.

Automobile economists see no cause for alarm over the months immediately ahead, and point to rising farm prices and sustained employment and national income as favorable external factors. Sales organizations are watching the day-by-day situation closely, but field stocks of both new and used vehicles are said not to be out of hand. Nevertheless, aggressive sales and advertising programs are underway to forestall any lack of interest in March or during the anticipated spring bulge in sales.

Parts makers passed their peak in December, which is normal because they work well in advance of assembly plants. A strong belief exists that operations of parts and accessory makers will be well cushioned for several weeks at least.

MILLIONS FOR NEW DIES

DETROIT—Approximately four million dollars worth of die business is being placed with independent shops by Nash, Hudson and Packard, which are making extensive body changes, particularly fenders, grilles and wider passenger compartments. Studebaker will also make many changes, but the die work will be confined to suppliers of Studebaker stampings. General Motors has placed parts of the overflow from the largest die program in years. Chrysler is delayed because of the strike last fall. It is reported that Ford is planning to place body dies for a new six-cylinder car with outside shops about April. This car will probably have different lines than the 85-hp. V-8; however, the program is not definite and can be shelved at any time. Considerable machine tool equipment has already been purchased for the six.

CUTS NORMALIZING COSTS BY COMBUSTION-CONTROL METHOD

LANSING, MICH.—Starter ring-gear blanks are being normalized by the Wohlert Corp., Lansing, Mich., at a saving of $5 per ton over the previous method through the use of a furnace

Surface Combustion Corp.

Double-Duty Furnace—*Wohlert Corp. finds that cost of normalizing starter ring gears is reduced $5 per ton with this furnace, and that the equipment is also suitable for low-temperature work because of "Conjecto-Firing"*

Vacuum Test—*A specially designed vacuum apparatus is used by Chrysler for checking thoroughness of body sealing. A fixture fits a window and connects to a vacuum pump and gage. With all windows closed, the pump can maintain a vacuum of one inch of water within the body if the sealing is adequate. This is roughly the suction produced when the car is driven 60 m.p.h.*

equipped with a new method of firing. In addition, much better work is being obtained, reports F. Wohlert, Jr., president. While the furnace was installed primarily for normalizing at 1,600 F., it is occasionally used for drawing gears after hardening, using the low-temperature burners at 750 F.

The new furnace is a convection type employing "Conjecto Firing." Convection heating depends upon circulation of a large volume of gases, but ordinarily a minimum volume of hot gases is available when the burners are turned down for low-temperature work. With Conjecto-Firing, an additional volume of air is introduced at low temperatures, the air being automatically mixed with the hot products of combustion. This is accomplished by means of twin burner nozzles in the same casting.

At low temperatures, air is injected through one nozzle, the gas to that nozzle being shut off. At higher temperatures, such as required for annealing, normalizing, carburizing and hardening, both nozzles function in the usual manner. But the burners can be adjusted so that the two nozzles are of different capacity. Thus, it is possible to shut off only the high-capacity burners by automatic or manual control when close to the desired temperature.

In the Wohlert installation, 238 lb. of gears and 49 lb. of fixtures comprise a charge of 287 lb., which is heated to 1,600 F. in 30 min. and soaked for 24 min. Gas consumption per pound of net charge amounts to 0.88 cu.ft. of 1050 B.t.u. gas.

BALL-BEARING STEERING GEAR IMPROVED FOR 1941 CARS

SAGINAW, MICH.—Saginaw Steering Gear Div., General Motors, will begin production of a new type of "recirculating ball-type steering gear" in about a year's time, according to Alva W. Phelps, general manager. Plans are now being drawn for a new building in which to manufacture the device, and it is expected that employment will be given to several hundred additional people. No G. M. division or outside customer has yet made commitments to use the new steering gear, says Mr. Phelps.

The recirculating-ball type gear consists of a worm with a ground helical groove running within a nut with a similar ground mating groove, the grooves being filled with steel balls. The combination acts as a screw and nut with rolling instead of sliding action.

To convert reciprocating motion of the nut into rotary action of the pitman-arm shaft, rack teeth are cut in the nut. The pitman-arm shaft is made integral with a pinion meshing with the rack. Contact between the nut and rack is not normal, the rack being slightly tilted. This allows the pinion to be moved into or away from the rack to compensate for manufacturing variations and wear in service. The rack is an ordinary straight-sided type, and the pinion is generated in a gear shaper with the cutter head tilted at an angle with the work. Thus, the proportion of the addendum and the dedendum varies across the face of the pinion tooth.

To allow for greater wear on the surfaces in contact when the gear is in the "straight ahead" position, the teeth are cut so that they mesh closely in the central position, but have a certain amount of backlash in off-center positions. It has been found possible to reduce such backlash to a fraction of that found in present designs.

SOVIET PURCHASES HEAVY

NEW YORK—Soviet Russia bought $20,900,000 of goods in the United States during December. More than half of it was productive machinery, factory equipment and special types of machine tools, according to the American-Russian Chamber of Commerce. Many of the orders were in connection with tooling for a new midget car. Russia's total purchases of all goods in the U. S. last year totaled $70,000,000.

More War Department Orders

WASHINGTON—Norris Stamping & Mfg. Co., Los Angeles, has received an order from the War Department for cartridge cases costing $502,000. Bethlehem Steel Co. will supply shell forgings valued at $121,728. Morton Mfg. Co., Muskegon Heights, Mich., has been awarded an Ordnance Department contract for a milling machine valued at $126,490. Leece-Neville Co., Cleveland, will build diesel engine parts for the Norfolk Navy Yard at cost of $76,565.

U. S. Government Contracts Awarded to Machine Tool Makers

(Other Metal-Working Awards on Page 104d)

Contractor	Gov't. Agency	Commodity	Amount
Wayne Tool Co., Waynesboro, Pa.	Navy	Reamers, countersinks..	$12,754
Crescent Tool Co., Jamestown, N. Y.	Air Corps	Pliers	12,072
Cincinnati Planer Co., Cincinnati, Ohio	Navy	Planer	17,121
William Sellers & Co., Philadelphia, Pa.	Navy	Planer	29,512
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.	Navy	Arc welders	16,220
Walworth Co., Boston, Mass.	Navy	Wrenches	11,241
Warner & Swasey Co., Cleveland, Ohio	Ordnance	Turret lathe	21,043
Fosdick Machine Tool Co., Cincinnati, Ohio.	Navy	Radial drills	32,430
Hendey Machine Co., Torrington, Conn.	Navy	Lathes	29,686

APPOINTED PLANE ENGINE AGENT

MONTREAL—Canadian Car & Foundry Co. has been appointed general agents of the Rolls Royce Co. and will overhaul and maintain Rolls Royce engines to be installed in Canadian - built planes in increasing numbers over the next few years.

1939 WAR IMPLEMENT EXPORTS SURPASS $100,000,000 MARK

WASHINGTON—The United States exported aircraft, aircraft engines and plane accessories totaling $99,760,958 during 1939. Of that amount France and Great Britain together took $69,176,268 or about 70 per cent. Aside from aircraft U. S. exports of implements of war last year were only $3,700,626.

The Netherlands and the Dutch East Indies were the biggest foreign purchasers of aircraft except the Allies. Holland itself took aircraft valued at $3,292,057 and the Dutch East Indies $5,847,426. It is known that a new large arsenal is being constructed in the Dutch East Indies to which were shipped last year $582,989 of goods listed in category B (guns, ammunition, grenades, bombs, torpedoes, mines, depth charges and discharge apparatus, and armored motor vehicles). Rumania bought $835,000 of goods in category B.

Mexico's purchases of planes and plane parts totaled $2,838,376, and Canada's $2,487,238. Russia bought aircraft valued at $1,097,015.

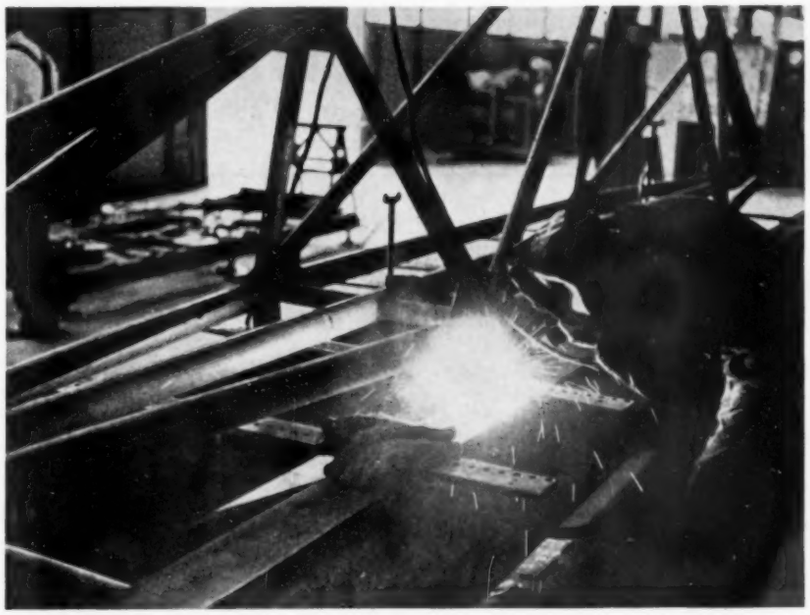
Exports are listed in the following table:

Major 1939 Exports of Arms, Ammunition and Implements of War*

Country	Category (see notes) A	B	C	A+B+C
Argentine	$1,344,959	$16,403	$34,585	$1,395,947
Australia	1,859,688	13,344	.....	1,873,032
Belgium	206,718	57,508	.....	264,226
Brazil	1,687,795	141,390	.....	1,829,185
Canada	2,487,238	141,346	369,123	2,997,707
China	1,423,519	151,755	437,499	2,012,773
Columbia	536,998	9,617	6,182	552,797
Finland	331,714	15,733	.....	347,447
France	38,017,590	1,132	2,200	38,020,922
Great Britain	31,158,678	100,046	277,467	31,536,191
Ireland	243,598	31,477	.....	275,075
Japan	992,210	6,380	.....	998,590
Mexico	2,838,376	121,485	65,532	3,025,393
Netherland	3,292,057	63	52,799	3,344,919
Netherland Indies	5,847,426	582,989	.....	6,430,415
Peru	1,295,897	38,715	39,282	1,373,894
Poland	257,741	1,452	.....	259,193
Rumania	30,160	835,000	.....	865,160
Sweden	307,758	1,363	.....	309,121
Thailand	416,867	30,938	.....	447,805
Turkey	641,891	75,370	.....	717,261
Russia	1,097,015	.....	.....	1,097,015
Venezuela	445,065	21,970	20,481	487,516
	$99,760,958	$2,395,476	$1,305,150	$103,461,584

* Figures represent 86 per cent of total exports to all countries.

NOTES: Category *A* includes aircraft, aircraft engines and all accessories.
Category *B* includes guns and ammunition, grenades, bombs, torpedoes, mines, depth charges and discharge apparatus, and armored military vehicles.
Category *C* includes high explosive powders and chemicals.



For Handier Handling—*Welding in the aircraft industry includes not only the planes themselves but also jigs, fixtures, and even handling equipment. Here it is being used in assembling a special frame for picking up completed Boeing "Stratoliner" fuselages. Photograph courtesy Lincoln Electric Co.*

Aircraft Orders Increase in Prominence As Britain Boosts Purchases in Canada

MONTREAL—The British and Canadian governments have recently placed, or are about to place, orders for some $60,000,000 combat planes, in addition to the contracts recently announced for training planes for the Empire air pilot training program.

A second order from the British government for Canadian Associated Aircraft, announced in the last issue of *American Machinist*, valued at $30,000,000. This is three times the amount of the company's first order for $10,000,000 of Hampden bombers.

Additional bombers of the Hampden type are to be built, although later four-motor Sterling bombers may be produced. Parts, as was the case with the initial order, will be turned out by the six companies owning the central company—Ottawa Car & Aircraft, Ltd.; Canadian Car & Foundry Co. of Montreal and Fort William; Fleet Aircraft of Fort Erie, Ont.; National Steel Car Corp. of Toronto; DeHavilland Aircraft of Toronto; and Fairchild Aircraft of Montreal. Assembly work will be handled by Canadian Associated Aircraft with offices in Montreal.

British orders, now being concluded, for additional Hurricanes from Canadian Car & Foundry, and possibly some planes from others are expected to run to at least $5,000,000 more.

The Canadian government has placed, or is about to place, orders for about $25,000,000 of plans for use by the Canadian National Defence Forces. Of that amount at least $10,000,000 will be ordered from Canadian companies, about half from Toronto airplane manufacturers and half from Montreal companies. It is expected that the contracts will include orders for additional Stanraer twin-engine flying boats from Canadian Vickers Co., and Bolingbroke bombers from Fairchild Aircraft.

WATCHING WASHINGTON

McGraw-Hill Washington Bureau

PAUL WOOTON, CHIEF

Treasury clarifies its position on allocation and priority of plane deliveries. More defense bills prominent in Congress, with emphasis of modernization of naval and aircraft forces.

WASHINGTON—Airplane manufacturers are keeping clear of the dispute between the War Department and the Treasury over Secretary Morgenthau's interference in allocation and priority of airplane deliveries. The Aeronautical Chamber of Commerce was opposed to Morgenthau's plans at first, thinking he might turn deliveries to the Allies, leaving stand-by customers in South America and elsewhere to go short. But upon being assured that such is not the intention, the Chamber withdrew.

The aircraft industry and the Washington Government are pleased with heavy plant expansion at the expense of the Allies, despite all talk to the contrary. Besides rolling up employment and profits for this country, the expansion has an international strategic angle. With the world's biggest airplane production plant, which we will soon have, the United States would not only be a dominant air power, it could make or break other powers by choosing whether or not to sell them equipment. Our monthly airplane capacity will soon be 1600 planes, equal or better than Germany's, since she is now running short of material.

Italy Not to Build Allies' Planes

The European countries have been pulling some fast ones lately. The Allies tried to buy airplanes from Italy, and Italy wanted to sell them, but had no materials. First these modern Romans approached the United States for sub-contracts on production for the Allies, and supposedly were turned down. Then Italy asked the Allies to send materials to be fabricated into planes and sold back to France and Britain. But the Allies were afraid to trust Italy with a volume of materials, and sent it to her in piece lots. This plan looked all right till Adolf told Benito to stop it.

Congress to Pass On Important Bills

Some of the bills before Congress of special interest to the metal-working industry:

Urgent deficiency bill, $57,541,300 for this fiscal year ending June 30, contains $29,000,000 for continuing naval construction, armor, armament, ammunition; signed by FDR.

Emergency supplemental bill, $252,135,536 for this fiscal year ending June 30, for War, Navy, Coast Guard, Federal Bureau of Investigation; cut $19,863,000 under budget by Senate-House conferees. It has been signed by FDR.

Navy supply bill, 1941, $966,772,878, has just been introduced in the House. It carries funds to start 19 warships, including two 45,000-ton dreadnaughts; for 352 airplanes, including 305 replacements (Navy had asked for 576); $22,553,250 contract authority for airplanes, ordnance, to be paid for with future appropriations (this figure was cut $16,000,000 under the budget by writers of the bill); $1,000,000 to improve Guam Harbor—with a limit of $3,000,000 proposed in fear of offending Japan, only 1,500 miles distant.

Navy expansion authorization, which would increase the establishment by 25 per cent, has dwindled from a 6-year, $1,300,000,000 program to a 2-year $665,000,000 plan. House Naval Affairs is reporting it to the House as this is written.

Bureau of Standards, has an appropriation of $2,037,500 in the State-Commerce-Justice Department supply bill for 1941 which has passed the House. The figure is much smaller than in recent years, when the Bureau was financing an electrical laboratory, additional land, and a housing study.

Civil Aeronautics Authority, asked for $37,210,181 in 1941 and wound up with Senate passing the bill at $27,721,954. CAA is not grieving; apparently the big figure was for trading purposes. Pilot training got $5,000,000; one million of that will be spent for advance training of the program's "graduates."

Maritime Commission asked for $200,000,000 to replenish its revolving fund, and for $150,000,000 additional contractual authority. It had $445,000,000 contract authority, voted by previous Congresses. After much cutting and restoring by committees, the Commission now has: $164,000,000 appropriation, and no new contract authority. It's in the Independent Offices bill, which has passed the House and Senate and is in conference committee. The revolving fund is used for ship construction subsidy, for ship operating subsidy, and for Commission administration.

TRADE AGREEMENT TO GET O.K.

WASHINGTON — Extension of the reciprocal trade agreement authority by the administration is virtually assured. The only question is whether the Senate will insist upon the right to ratify every agreement, thus practically nullifying the administration's power. The probability is that no such "string" will be attached. The administration has mollified several of the bitterest elements opposing the agreements by promising that copper should not be in the Chilean agreement and by abandoning the Argentine negotiations when Buenos Aires refused to accept a quota on linseed oil. This concession to such a numerically small group as the flax growers shows how carefully the State Department has been treading since the attacks on reciprocal agreements began.

War Booms U. S. Shipbuilding

This country has huge stocks of surplus out-dated war supplies and among them may be included our fleet of 113 laid-up merchant ships, all over-age but serviceable. President Roosevelt is considering whether the ships should be sold along with other goods to Allies and neutrals.

The National Council of American Shipbuilders reports the availability of 83 active ways, 62 of them on the Atlantic Coast, all 300 feet long or more, with a capacity of 166 average merchant ships totaling about 1,000,000 gross tons a year. This capacity could be increased 50 per cent by conditioning 37 inactive ways now partially dismantled. Thus there is no capacity shortage, as sometimes reported.

President Frank J. Taylor of the American Merchant Marine Institute, expects that more and more steamship companies will take advantage of war boom prices and dispose of the over-age tonnage abroad. If he is right, the Maritime Commission will find ready acceptance of modern ships it wants to build.

Meanwhile the Commission has announced that Socony-Vacuum Oil Company will start construction of six national defense tankers. Commission's total tanker program is 24; of the number nine have been launched and three are nearing completion.

Also announced, last week, was the Commission's invitation for bids for construction of two trans-Pacific luxury liners, for quick conversion into aircraft carriers. This will be the first design of its kind.

PRODUCTION PROBLEMS TO BE DISCUSSED BY TOOL ENGINEERS

DETROIT—Thirty prominent speakers will address the 1940 annual meeting of the American Society of Tool Engineers to be held in New York, N. Y., March 7-9. A symposium on the economics of tooling will cover production planning and describe successful tooling methods. Papers on this subject will be given by B. G. Tang, general superintendent, General Electric Co.; W. F. Stegemerten, superintendent of equipment and methods, Westinghouse Electric & Mfg. Co.; J. M. Crawford, assistant superintendent, Generator and Motor Section, General Electric Co.; F. E. Darling, Wage Standards Department, Eastman Kodak Co.; and W. J. Peets, assistant superintendent, Singer Mfg. Co.

Screw Machines Noted

Tooling for plastics will be discussed by J. E. Stewart, general foreman, Plastics Department, Ford Motor Co.; W. B. Ross, Die Molding Co.; and F. W. McIntyre, Reed-Prentice Co. These papers will tell some things that can't be done, as well as some of the things that can and will be done, with plastics.

Subjects in screw-machine tooling, including a new system for calculating top rake on form tools, and latest set-ups for automatics, multiple-spindle machines and turret lathes, will be presented by H. P. Berry, editor, *Screw Machine Engineering* and senior tool and gage designer, Naval Gun Factory, Washington, D. C.; M. W. Taylor, foreman, Screw Machine Department, Wright Aeronautical Corp.; C. G. Stevens, mechanical superintendent, New Departure Division, General Motors Corp.; and L. G. Gilbert, manager, Time and Methods Department, Columbus-McKinnon Chain Corp.

One session of the meeting will be devoted to design of punches and dies. The speakers will be W. T. Forde, manufacturing supervisor, International Business Machines Corp.; G. L. Reed, chief engineer, York Corrugating Co.; and F. D. O'Brien, master mechanic, Tool Department, Eastman Kodak Co.

Training to Be Outlined

A plan for covering the fundamentals of tool engineering training in high schools will be presented by B. L. Bowsher, superintendent of schools, Toledo, Ohio. T. P. Orchard of the Technical Evening Classes, Paterson, N. J., will show where the vocational schools fit into this picture. Dean J. W. Barker, Columbia University, will discuss the possibilities and limitations of universities in teaching tool engineering. Industry's needs for trained tool engineers will be told by Clifford S. Stilwell, executive vice-president, Warner & Swasey Co.

A session will be devoted to cutting tools and materials to determine their most economical and productive useage. Papers have been prepared by W. G. Robbins, president, Carboloy Co.; L. C. Gorham; E. S. Chapman, general works manager, Chrysler Corp., Plymouth Division; and A. H. d'Arcambal, Pratt & Whitney Division, Niles-Bement-Pond Co.

American development of equipment and methods to produce precision small gears will be related by Tom Turner, manager, Meter Division, Westinghouse Electric & Mfg. Co.; G. H. Sanborn, Fellows Gear Shaper Co.; Arnold Thompson, chief designing engineer, Canadian Acme Screw and Gear Co.; and a representative of the Barber-Colman Co.

Progress reports, installation of officers and the final report of the A. S. T. E. Fact-Finding Committee will be presented at the Annual Dinner.

Charles Thiede, at left, chief tool engineer of the Chrysler Jefferson plant, and present chairman of the Detroit Chapter, A.S.T.E., congratulates Clyde Hause, who becomes chairman in April. Background—B. L. Diamond and Clyde Mooney

CANADIAN PARTS MAKERS BUSY

MONTREAL—Considerable part of the castings and forgings for the naval craft and freighters to be built in Canada will be handled by Canadian Car & Foundry. It will produce main frames, propellor shafts and like materials at its foundry at Longue Pointe near this city.

Robert Mitchell Co. of this city has made arrangements with Noorduyn Aviation Co., Ltd., to handle the aircraft casting work and a large part of the machine work in connection with Noorduyn's new airplane orders. The Mitchell company also is likely to provide aluminum castings for the new bombers to be built by Canadian Associated Aircraft. Castings for the first bombers were imported from England.

More Educational Orders Let

WASHINGTON—The War Department has made the following awards: Harrington & Richardson Arms Co., Worcester, $192,497, for automatic pistols; Singer Mfg. Co., Elizbeth, N. J., $278,875, for automatic pistols; National Cash Register Co., Dayton, $70,132, metal components for fuzes; Federal Screw Works, Detroit, $72,040, metal components for fuzes; Fulton Syphon Co., Knoxville, $101,991, metal components for fuzes; Philadelphia Storage Battery Co,. $133,485, metal components for fuzes; James Cunningham & Son Co., Rochester, $62,-856, carriage assemblies for machine guns; York Safe & Lock Co., York, Pa., $57,050, cradle assemblies for machine guns.

Navy contract awards include: William Sellers & Co., Inc., $143,200 for openside planer and radial drills; R. K. Le Blond Machine Tool Co., $48,500, for lathes; Reid-Avery Co., Baltimore, $138,246, for welding electrodes; Hollup Corp., Chicago, $42,250, for welding electrodes.

Rush Job—*Structural steel for Electric Boat Company's 142,000-sq.ft. addition to its Bayonne, N. J., works was erected rapidly to help complete the plant by March 12. Welded trusses and other stock structural members helped speed construction. Plant was designed and is being built by The Austin Company*

PLANT EXPANSION

Carnegie-Illinois Steel Corp. is planning construction of 142 new coke ovens at its Gary, Ind., plant. Cost is estimated to be over $5,000,000.

General Electric Co., Schenectady, N. Y., is planning to increase production of Glyptal resin approximately 50 per cent after March 1, when additional manufacturing equipment will be put in operation.

IES Mfg. Co., Middletown, Conn., automotive parts manufacturer, has begun operations with a skeleton force. ERNEST SCHWARTZ, president, has announced that about 75 men will be added to the payroll soon.

Laminated Shim Co., Long Island City, N. Y., has begun work on a new plant located in Stamford, Conn. Building will be a modern one-story structure providing about 30,000 sq.ft. of floor space. Move is being made because of the acute need for larger manufacturing space.

Lockheed Aircraft Corp., Burbank, Calif., is planning construction of an airplane assembly building costing $15,000.

Monsanto Chemical Co., St. Louis, Mo., spent some $4,200,000 for plant improvement in 1939, and is planning expenditure of an even larger sum for the same purpose in 1940, according to CHARLES BELKNAP, executive vice-president.

Joseph T. Ryerson & Son, Inc., has expanded its Philadelphia steel-service plant by about 250,000 sq. ft.

Square D Co., Milwaukee, Wis., has purchased an eight-acre factory site in that city and plans to construct a one-story factory this year. New plant will have about 120,000 sq.ft. of floor space, which will about double the area of the present three-story factory.

Zierold Metals Corp., recently incorporated in Los Angeles, Calif., has occupied a larger plant in nearby Burbank, to which a new unit will soon be added.

BUSINESS ITEMS

Bolens Mfg. Co., Port Washington, Wis., has purchased all the property of the Gilson-Bolens Mfg. Co., and will conduct the entire business of manufacturing garden tractors, power lawn mowers, and office furniture.

Consolidated Steel Corp. has purchased the Orange, Tex., plant of the Orange Car & Steel Co., and will enter the oil industry supply field.

Hanson-Van Winkle-Munning Co., Matawan, N. J., has acquired the Consolidated Brush Corp. of New York City. LEO J. SPRINGER, president of the brush concern, has joined the Hanson-Van Winkle-Munning organization.

Kearney & Trecker Corp. announces the outright purchase of the Dalrae Tools Co., Syracuse, formerly owned and operated by the late William L. McRae. The manufacture of these products, "Speedmill" and "Midgetmill' (motor driven attachments for milling machines), will be carried on at the Milwaukee plant of Kearney & Trecker.

Joseph Reid Gas Engine Co., Oil City, Pa., has purchased the marine and industrial engine manufacturing equipment of the Lycoming Mfg. Co.

Stow Mfg. Co., Binghamton, N. Y., has acquired the rights to manufacture and sell "Whirlflex," a mechanical piping cleaner from the Whirlflex Co., Buffalo, N. Y.

Wesley Steel Treating Co., Milwaukee, Wis., has been licensed by Globe Steel Tubes Co. to use its newly developed "Ihrigizing" process.

NAMES in the NEWS

WARREN J. BELCHER has been appointed vice-president and RICHARD L. MULLANEY assistant general manager of the Whitney Chain & Mfg. Co., Hartford, Conn. Mr. Belcher, for 33 years active in the development of the company's products, will be in charge of engineering. Mr. Mullaney will serve as his assistant.

PETER V. BOUTERSE has taken over active management of Excel Foundry & Machine Co., Lebanon, N. J., of which he is president. His headquarters will be in New York City.

DR. FRANK CONRAD, assistant chief engineer Westinghouse Electric & Mfg. Co., received the Gold Medal of the American Institute of the City of New York for "his pioneering work in short wave and frequency modulation and for his guiding genius in developing the world's first radio broadcasting system."

J. M. COSGROVE, formerly chief chemist of Noblitt-Sparks Industries, Inc., has been appointed director of the development laboratory of Standard Steel Spring Co., Coraopolis, Pa.

ROBERT L. JOHNSTONE has been named general manager of the Ajax-Shaler Shaker Division of Ajax Flexible Coupling Co., Westfield, N. Y.

JOHN D. KERRINS, associated with Sprague Meter Co., Bridgeport, Conn., in an advisory capacity, has been appointed assistant manager.

M. H. KUHL has been named assistant manager of the Industrial Division of Timken Roller Bearing Co., Canton, Ohio. He succeeds S. D. PARTRIDGE, who was made manager of the division recently.

E. J. LEISER retired Feb. 15 as superintendent of the Milwaukee works of the International Harvester Co., after being associated with the firm for 35 years.

H. R. MACMILLAN, prominent industrialist of Vancouver, B. C., has been

elected a director of The International Nickel Co. of Canada, Ltd., filling the vacancy caused by the death of JAMES A. RICHARDSON.

FRANK L. MATHES, JR., formerly head of the standards department of Eagle Lock Co., Terryville, Conn., has been named assistant to ROLAND PLUMB, vice-president. He is succeeded by JAMES A. ROBINSON. PHILIP F. ATWOOD, a member of the superintendent's staff, has been appointed factory superintendent.

C. H. MCGRATH, former general purchasing agent for the American Brake Shoe & Foundry Co., has been appointed assistant to the president. He is succeeded by W. T. KELLY, JR., formerly assistant general purchasing agent.

RALPH B. MEISENHELDER has been appointed assistant to STEWART E. LAUER, president of York Ice Machinery Corp., York, Pa.

CARL F. OBERMAIER, for the past 29 years manager of the York, Pa., wire works of the General Electric Co., has retired. F. R. KAIMER, who has been Mr. Obermaier's assistant for the past ten years, has been named general superintendent of the factory.

H. P. BINDER, sales engineer connected with the Centrifugal Pump Division of Allis-Chalmers Mfg. Co., Milwaukee, Wis., has been appointed assistant manager of that division.

Mr. Binder, a graduate of Purdue University, entered the company's training course in 1911. The following year he entered the hydraulic engineering department where he served until 1917, when he joined the 9th Field Artillery of the regular army. At the conclusion of the war he resigned with the rank of Captain, and

H. P. BINDER

returned to Allis-Chalmers in 1919. In the company's Centrifugal Pump Division he took up sales engineering work, which he followed until his recent appointment to the new executive post.

H. G. R. BENNETT

W. A. JAYME

C. M. NYSTROM

HERBERT G. R. BENNETT, since 1933 assistant general superintendent at the Duquesne, Pa., works of the Carnegie-Illinois Steel Corp., has been appointed to the staff of the corporation's chief engineer at Pittsburgh. WALTER A. JAYME, general superintendent of the McKeesport plant, has been named assistant general superintendent of the Duquesne works, succeeding Mr. Bennett, while CARL M. NYSTROM has been appointed general superintendent of the Wood works.

Mr. Bennett was first employed by a subsidiary of U. S. Steel in 1901. In 1907 he joined the former Carnegie Steel Co. at Youngstown and subsequently worked for the company in Milwaukee. The following year he returned to Youngstown as special engineer, and in 1916 became master mechanic. He was appointed assistant superintendent of bar mills in 1925, and in 1933 was transferred to the Duquesne works as assistant general superintendent.

Mr. Jayme began his career as a metallurgist in 1921 following his graduation from M. I. T. He soon became a specialist in steel alloys and was associated with several alloy producing companies before joining the Metallurgical Division of Carnegie-Illinois in 1935. He became business manager of the Alloy Division the following year and was appointed general superintendent of the Wood works in 1937.

Mr. Nystrom, a native of McKeesport, has been employed at the Wood works during his entire industrial career. He began as metallographist in 1926, was appointed foreman of the chrome polishing and inspection department in 1928, and was named assistant general superintendent of the plant in 1937.

JOHN H. RASP has been appointed superintendent of the tool and die department of the Sintered Carbide Division of Firth-Sterling Steel Co., McKeesport, Pa. J. H. CHIVERS has been appointed superintendent of melting, filling the vacancy created by the death of L. B. KNOX.

E. R. REDFORD, for the past two years executive production engineer with Graham-Paige, has joined the Motor State Products Co., Ypsilanti, Mich., as assistant to the president.

L. N. SHANNON, vice-president and works manager Stockham Pipe Fittings Co., Birmingham, Ala., has been nominated for presidency of the American Foundrymen's Association. HERBERT S. SIMPSON, president National Engineering Co., Chicago, Ill., was nominated for vice-president.

Sales

J. W. BERRIMAN, for the past seven years manager of the New York branch of the Timken Roller Bearing Co., Canton, Ohio, has been granted an indefinite leave of absence due to an extended illness. His position has been filled by H. C. SAUER, who has been transferred from Chicago, where for the past nine years he has served in a managerial capacity. L. J. HALDERMAN, for the past ten years manager of the company's Kansas City branch, has been transferred to Chicago. He is succeeded by F. A. WEISENBERGER, formerly of the Pittsburgh sales staff.

FRIEDRICK BIRSCHEL, JR., Gaspar Campos, 1550, Vicente Lopez, F.C.C.A., Argentina, has been appointed South American representative for the American Foundry Equipment Co., Mishawaka, Ind.

THOMAS H. CORPE, formerly chief of the promotional departments of the Lockheed Aircraft Corp., has been named general sales manager of Vega Airplane Co., Burbank, Calif., a Lockheed subsidiary.

THOMAS C. DELANEY, Brooklyn, N. Y., has been appointed foreign sales manager for the Ball & Roller Bearing Co., Danbury, Conn.

TOMLINSON FORT has been named assistant manager of central station sales for the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

JOHN R. HERTZLER has been named general sales manager of York Ice Machinery Corp., York, Pa.

L. E. PHELPS has been placed in charge of the Milwaukee office of the National Tool Co., Cleveland, Ohio.

ALFRED C. SANGER, for the past several months sales manager of the General Electric household refrigerator section, has been named manager of the G.E. heating device and fan section. He succeeds C. J. HENDON, who has resigned after serving several years in that post. His position in turn is assumed by L. H. MILLER, former manager of merchandising services.

P. S. WISWELL, former Pacific Coast representative for the Norton Co., Worcester, Mass., and its Behr-Manning Division, will devote his entire time to the sale of Behr-Manning products. WARREN H. TURNER, Norton field engineer in the Detroit area, will take over the Norton southern California territory. E. G. PETHERICK, San Francisco grinding wheel specialist, will serve the northern California district.

WILLIAM K. BREEZE, New York district sales manager Jones & Laughlin Steel Corp., Pittsburgh, Pa., has been appointed Pacific Coast manager with headquarters in Los Angeles. JOHN B. DEWOLF, since 1938 district sales manager in Philadelphia, has been appointed district sales manager in New York. HERBERT B. SPACKMAN, assistant Philadelphia district sales manager, has been appointed district sales manager in Philadelphia.

H. H. LENTZNER has been made sales manager, Kearney & Trecker Corp., Milwaukee, to succeed E. Trecker, now works manager. Mr. Lentzner has been with the company since 1918 when he began working in the shop. He joined the sales organization in 1930 and for the past five years has been resident manager in Cleveland operating with dealers in the Cleveland, Pittsburgh, Cincinnati and Indianapolis territories. He also spent the first six months of 1939 in Europe for the company.

I. G. VANDERPAN has been made resident sales engineer with headquarters at Syracuse. This territory has been added to the New York territory which is under the management of R. F. Stuart (offices are at 1060 Broad St., Newark, N. J.). Mr. Vanderpan joined the company in 1926 and for the past six years has been eastern service engineer and assisted with sales in the New York territory.

CHARLES KOPECKY succeeds Mr. Vanderpan as sales and service engineer in the New York territory. He began with the company as an apprentice in 1928.

GEORGE G. HATHAWAY has been appointed sales manager at the home office of the International Machine Tool Co., Indianapolis, Ind.

Born in Providence, R. I., in 1894, Mr. Hathaway attended Providence Technical High School and the Rhode

GEORGE G. HATHAWAY

Island School of Design. For seven years he was employed with Brown & Sharpe Mfg. Co. in the engineering department. He later was connected with the A. O. Smith Corp., Milwaukee, Wis., as special machinery designer, and subsequently served the E. A. Kinsey Co., Indianapolis, Ind., as salesman. His next connection was with the Kingsbury Machine Tool Corp., of Keene, N. H., where he spent four years as sales manager. He later served the Jones & Lamson Machine Co., Springfield, Vt., for eleven years as sales engineer, Philadelphia salesman, and New York office manager.

WILLIAM S. SAYLOR has been appointed sales manager for the Boston district of Carnegie-Illinois Steel Corp., Pittsburgh, Pa. He succeeds WILBUR S. LOCKE, who retired the first of the year after completing 47 years of service.

OSCAR C. SCHMITT, formerly vice-president in charge of sales, Emerson Electric Mfg. Co., St. Louis, Mo., has been elected executive vice-president. RAYMOND E. OTTO, manager of motor sales, has been named manager of sales, while WILLIAM R. FRASER, New York City district manager, has been named manager of motor sales, located in St. Louis.

OBITUARIES

JOHN J. FASMER, 56, until recently general sales manager of the Stephens-Adamson Mfg. Co., Aurora, Ill., materials handling equipment manufacturer, died suddenly Feb. 3.

LAWRENCE J. HOLMES, 56, former superintendent of the Mack truck plant at Allentown, Pa., and former vice-president of the Mack Mfg. Corp., died Feb. 7 at his home in Lanark, Pa., following a long illness.

WILLIAM LUBENOW, 79, founder and owner of the Lubenow Mfg. Co., Milwaukee, Wis., screw machine manufacturer, died Feb. 3 at his home in that city.

T. S. PERKINS, who retired in 1933 as general manager of merchandising engineering for the Westinghouse Electric & Mfg. Co., died Jan. 7 in Irwin, Pa.

GUSTAV TILGNER, 93, an active partner in the Olsen & Tilgner Mfg. Co., Chicago, Ill., machinery maker, died Feb. 9 at his home in that city.

MAX UHLMANN, 83, president Bilgram Gear & Machine Works, Philadelphia, Pa., and prominent in the development of skew bevel gears, died Feb. 8.

SAMUEL M. VAUCLAIN, 83, who rose from a day laborer to become chairman of the Baldwin Locomotive Works, Philadelphia, Pa., died Feb. 4 of a heart attack.

MEETINGS

AMERICAN GEAR MANUFACTURERS ASSOCIATION. Annual convention, Grove Park Inn, Asheville, N. C., May 20–22.

AMERICAN IRON & STEEL INSTITUTE. Forty-ninth general meeting, Hotel Waldorf-Astoria, New York, N. Y., May 23.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Spring meeting, Hotel Bancroft, Worcester, Mass., May 1–3.

AMERICAN SOCIETY OF TOOL ENGINEERS. Annual meeting, Hotel New Yorker, New York, N. Y., March 7–9.

AMERICAN SOCIETY FOR TESTING MATERIALS. Spring meeting, Hotel Statler, Detroit, Mich., March 6. Annual meeting, Chalfonte-Haddon Hall, Atlantic City, N. J., June 24–28.

MIDWEST POWER CONFERENCE. Annual conference, Palmer House, Chicago, Ill., April 9 and 10.

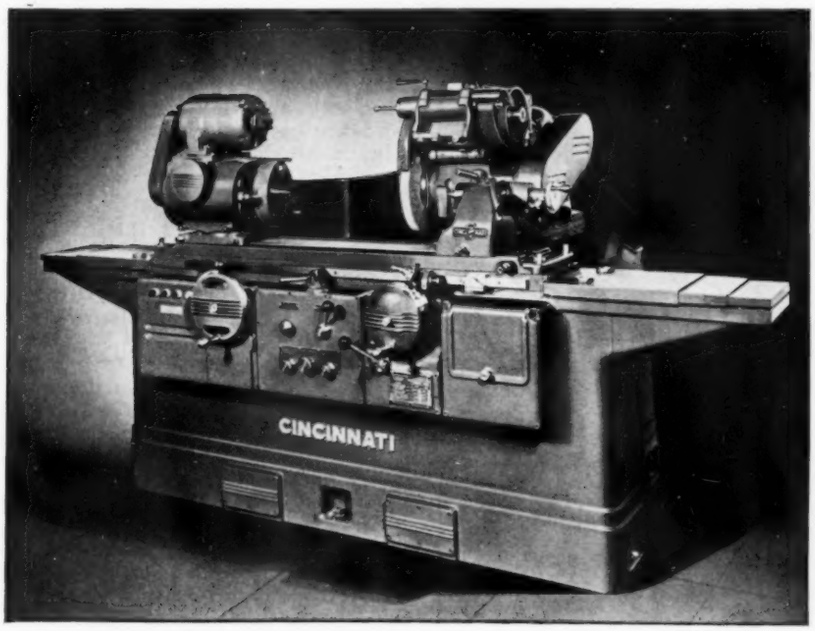
INTERNATIONAL ACETYLENE ASSOCIATION. Fortieth convention, Schroeder Hotel, Milwaukee, Wis., April 10–12.

SOCIETY OF AUTOMOTIVE ENGINEERS. National aeronautic meeting, Washington Hotel, Washington, D. C., March 14 and 15. National transportation and maintenance meeting, Mellon Institute, Pittsburgh, Pa., March 28 and 29.

SHOP EQUIPMENT NEWS

Mechanical Headstock Speed Changing Device Featured on Cincinnati Hydraulic Universal Grinder

The hydraulic universal grinder announced by Cincinnati Grinders Incorporated, Cincinnati, Ohio, features a new mechanical speed changing device, built into the headstock, eliminating the need for variable speed d.c. motors. Standard a.c. motors can be used. An infinite number of work speeds may be obtained, varying from 55 to 500 r.p.m., by merely rotating a small handwheel in front of the unit. The headstock may be swiveled at right angles to the grinding wheel for facing operations and, in addition, incorporates mechanism for quickly changing from live to dead spindle operation and vice versa. Automatic control of work rotation and coolant flow is included as a standard feature. By means of a selector valve, these automatic features may be cut out, and the work rotation and coolant flow controlled by hand.



This grinder has a swing of 12 in. and can be obtained in between-center lengths of 24, 36, 48 and 72 in. The table feed on this machine is actuated hydraulically from a circuit which supplies pressure on both sides of the piston. Feed rates are infinitely variable from 3 to 240 in. per min. At each end of the stroke, table tarry may be independently adjusted from 0 to 5 seconds, while the accuracy of reversal at any table speed is within 0.044 in. The stroke of the power table traverse with automatic reversal may be set as short as $\frac{1}{16}$ in. This short stroke produces an effect comparable to a grinding wheel spindle reciprocating attachment.

The table has two hand-controlled traverse rates—a fast movement of $\frac{1}{16}$ in. per revolution of the handwheel for setting up and long adjustments, and a slow movement of 0.100 in. per revolution for fine adjustments and for shoulder grinding. Mechanical hand traverse is supplied as standard equipment but, if desired, hand hydraulic table control may be substituted.

The hand infeed traverse of the wheelhead has two speeds. In high gear the unit moves at a rate of ¼ in. per revolution of the handwheel, while in slow gear it moves at a rate of 0.050 in. per revolution. For accurate sizing, the device may be adjusted in increments of 0.0001 in. reduction of work diameter. Automatic infeed at table reversal may be adjusted from 0.0004 to 0.014 in. Table ways are pressure lubricated with filtered oil and are protected by telescopic guards at each end of the table. All power operated mechanisms are either pressure lubricated or submerged in oil. Leveling jacks are built into the base at the floor line.

This grinding machine incorporates the recently announced "Filmatic" spindle bearings in the wheelhead. These bearings are of multiple shoe construction, steel backed and bronze lined, and are self-adjusting for variations in load resulting from heavy or light cuts. Completely submerged in oil, self renewing wedge-shaped oil films support the spindle at all times. A safety switch in the electrical circuit eliminates the possibility of operating the machine without an adequate supply of oil in the spindle bearing. The grinding wheel on one end of the spindle and the driving sheave on the other end are mounted close to the front and rear bearings respectively, reducing bending moment to a minimum. A 3 hp. motor mounted on top of the wheelhead unit drives the grinding wheel spindle.

A hinged-type internal grinding attachment is included as standard equipment. This unit is hinged to the front of the wheelhead; always in place for an internal job. This arrangement eliminates much of the setup time formerly required for internal work, as the operation is now reduced to swinging the attachment down and tightening one bolt. Even the belt may be left on the pulleys when the attachment is not in use. The electrical circuit is arranged to cut out wheelhead drive motor when internal grinding and vice versa.

Wittman Spacing Machine Lays Out and Punches

Holes can be spaced within 0.0005 in. with the marking layout and punching machine developed by G. F. Wittman, 20 Northwood Ave., Day-

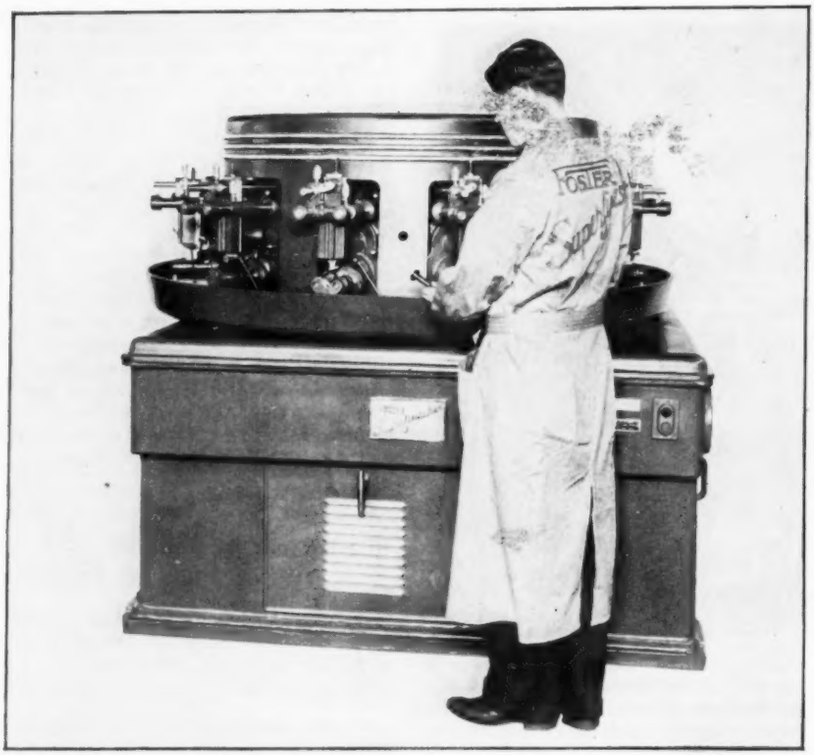
ton, Ohio. The only requirement for using the micrometer controlled spacing table is that of squaring two edges of the work at 90 deg. With the aid of three jig boring micrometers and end measuring rods of fixed length, the work is moved with respect to a fixed point so that other points may be accurately located. The machine is recommended especially for experimental work and for short-run production jobs. It has a capacity of 7½ tons, an 8-in. throat, and a ½-in. stroke with ¾-in. adjustment of the punch ram. Punches and dies are interchangeable, using a floating-type punch to assure accurate alignment. A centering device is provided for locating the work on the spacing table.

Twelve-Spindle Foster Superfinisher Operates Continuously to Finish Parts

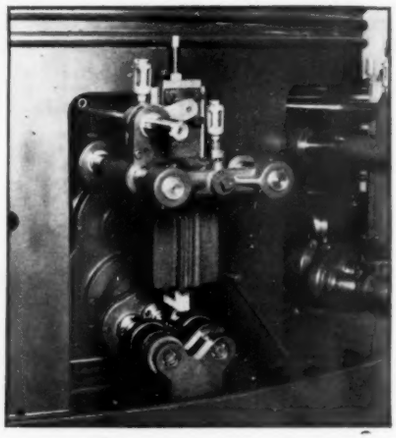
Arranged to superfinish valve tappet bodies in one of the large automobile plants, this twelve-spindle continuous type Superfinisher made by the Foster Machine Co., Elkart, Ind., has a fully automatic cycle. Each work spindle is equipped with a centerless drive, wherein the body of the tappet is rotated by the use of a pair of rolls. A superfinishing head is provided for each work spindle and, as each spindle approaches the unloading station, the superfinishing head automatically raises and the work spindle stops rotating. The tappet is removed and another is placed into the centerless drive. The superfinishing head then descends to the work as the rotation of the spindle starts.

Table of this machine is continuously rotating. All that is required on the part of the operator is the unloading and the loading of the new part when the superfinishing head is in its uppermost position and the spindle has come to a stop. In the operation of the superfinishing head there is a motion within a motion. In other words, the short oscillation is 3/16 in. in length and has a speed of 450 oscillations per minute. The longer motion is adjustable from 0 to 5 in. and travels at a rate of 0.060 to 0.080 per revolution of the spindle. This gives the combination of motions which is one of the principles of superfinishing.

Spindle speeds and table speeds of the machine can be changed quickly by the use of sheave wheels on the main drives. A change in the table drive will change the cycle of the machine. When arranged for tappet body finishing, production of this machine is approximately 900 parts per hour. This machine also can be arranged with a collet mechanism for holding work. When so fitted, the collets are opened automatically for the removal of the part at the end of the cycle, and will close automatically when reloading for the beginning of the next cycle.



Approximately 900 tappet bodies can be Superfinished each hour in this twelve-spindle Foster machine. Operation is automatic, except for loading and unloading



At the end of a cycle the head raises and the spindle stops rotating, permitting easy loading.

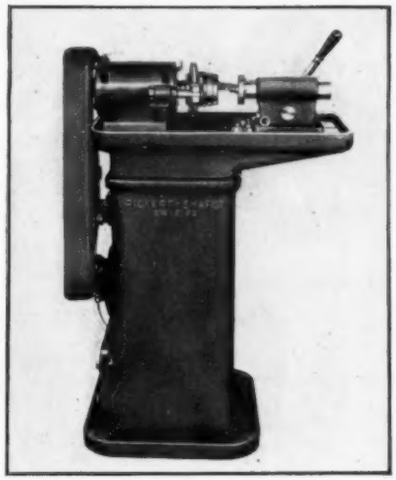
Oliver Cutter Grinder Has Traversing Wheelhead

The improved tool and cutter grinder offered by Oliver Instrument Co., Adrian, Mich., can be used for grinding all types of milling cutters and reamers with a minimum number of attachments. The adjustable wheelhead is equipped with Timken bearings. The work is held stationary and the grinding wheel traverses the cutting edge of the cutter. The wheel is carried on the forward end of a ram which slides in a fixed bearing at the upper end of the pedestal, the motor being carried on the rear end of the

ram and belted to the grinding spindle. Grinding wheel has a stroke of 10 in. and is traversed by a rack and gear actuated by a lever adjustable to the convenience of the operator. Face mills up to 14 in. diameter can be ground on the face and periphery at one setting of the cutter. Special fixtures have been developed for grinding round corners on end mills, for grinding small end mills, for broach grinding, tap grinding and drill point thinning.

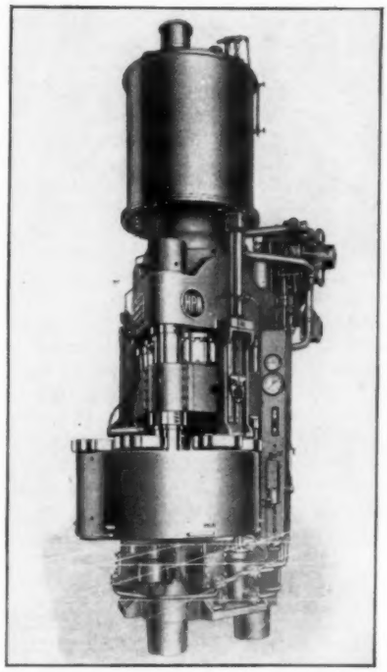
Rickert-Shafer Threader Has 3-4-in. Capacity

The improved horizontal hand threading and tapping machine announced by Rickert-Shafer Co., 613 W. 11th St., Erie, Pa., is designed for use wherever a variety of "second operation" threading and tapping jobs must be performed. This machine has capacity to ¾ in. diameter. Either Model C self-opening die heads or collapsible taps may be used



on the ball bearing spindle. Suitable work holders can be provided for a wide variety of production threading. The motor drive incorporates a three-speed V-belt arrangement.

H-P-M Cartridge Case Heading Press Incorporates Six-Station Turret Table



This turret-type cartridge case heading press, built by the Hydraulic Press Mfg. Co., Mt. Gilead, Ohio, is of standard "Fastraverse" design, except that it has three strain rods instead of the conventional four. Three-rod design permits a six-station turret to revolve clockwise around one of the rods, so that the pressing position is directly beneath the pressure ram. The station preceding the heading position can be used as an indenting station, by placing an indenting tool on the main platen, and the station directly following the heading position is the ejecting station. The remaining three stations, which are outside of the press, are used for loading. Time for loading and ejecting do not enter into the time cycle as is the case with single-action presses without turret operation. Production with the turret-type press is claimed to be four to five times that of a single-action press without turret.

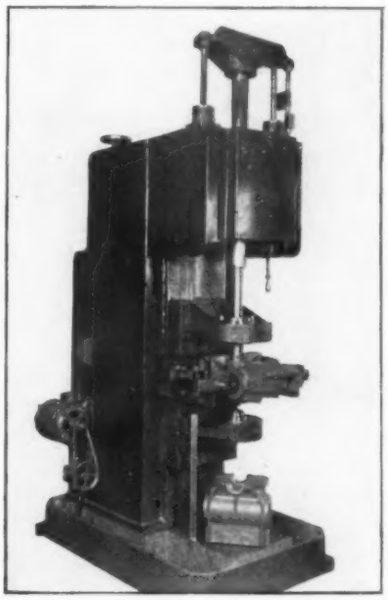
The press platen is fitted with an air-operated sliding tool holder which will accommodate two heading tools. If the cartridge case requires both tools, two pressure strokes are used; the tool holder automatically sliding the alternate tool into position prior to each pressure stroke. If only one heading tool is required, the tool holder remains stationary.

During the pressing operations, the turret is solid against the bed. Before indexing, two hydraulic rams beneath the turret automatically lift the turret to contact a central roller bearing on the axial strain rod. A d.c. gear motor, with magnetic brake, automatically revolves the turret.

Cartridge cases are ejected automatically by an hydraulic ram beneath the ejecting station. A manually operated air hoist, with automatic clamping fixture, lifts the headed case clear of the turret. The press cycle is semi-automatic, it being necessary for the operator to start each complete cycle by pressing a pushbutton. These heading presses are available with maximum tonnages ranging from 500 to 3,000 tons. This range will accommodate shell sizes from 37 to 155 mm. Each press is equipped with the "Hydro-Power" closed circuit operating system with valveless connection between pump and pressure cylinder. Oil is used as the pressure medium, serving also as a lubricating agent. On the 550-ton press a 40-hp. motor drives the radial pump; all of the larger sizes require a 100-hp. motor.

Gatco Carbideborer Guides Boring Bar in Bushings

The Model W 101 "Carbideborer" carbide and diamond boring machine offered by the Giern & Anholtt Tool Co., 1312 Mt. Elliott Ave., Detroit, Mich., is used for semi-finish and finish boring deep holes. The boring bar is guided on both sides of the bore by rotary precision bushings. Frame of this boring machine is of



welded steel construction, with a cast-iron base plate. Spindle is 3⅜ in. diameter and is driven by an "hour glass" wormwheel. The worm, in turn, is driven by V-belt step pulleys. Speed ranges are from 100 to 550 r.p.m. Hydraulic spindle travel is 20 in. Diameter of bores ranges from 2 to 5½ in.

Danly Guide Post Covers Insure Against Accidents

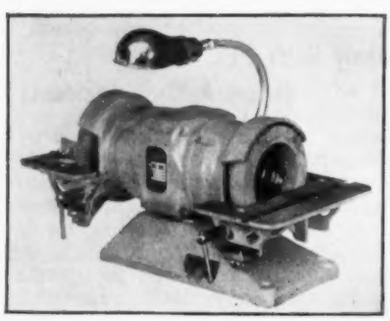
Safety guide post covers offered by Danly Machine Specialties, Inc., 2104 S. 52nd Ave., Chicago, Ill., provide automatic insurance against punch press operators losing fingers, hands or arms by getting them caught in gaps when bushings leave guide posts in the operation of punch press dies.

These covers are available in three types, including a one-piece cover which protects the gap only, as shown, a telescoping cover for the gap only, and telescopic covers for the entire guide posts and gaps. The latter type gives the added advantage of inclosing guide posts and bushings completely, protecting them from damage from any source. Simple, positive oilers can be incorporated in the top unit of all three types of these covers. In these oilers, a metal-inclosed felt sealing ring

is inserted in the top unit to act both as a seal and as a wiping oiler at each stroke of the press. The guide post covers are easily attached or removed. They can be applied to new dies, or to dies now in use, without any redesign, as in most cases clearances are ample for their use.

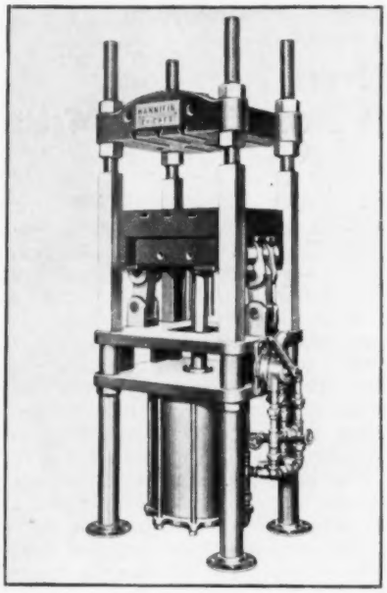
Baldor Tool Grinder Has Heavier Shaft

The improved carbide tool grinder offered by the Baldor Electric Co., 4351-59 Duncan Ave., St. Louis, Mo., is said to operate with a minimum of vibration, as it has a heavier and shorter shaft, and it is claimed that the armature has no end play in either direction. Powered with a ½ hp., 3,400 r.p.m. ball bearing reversible motor, this grinder has adjustable 10 x 3½ in. tool rest tables at each end. A protractor is mounted at each side of the grinder to indicate the angle setting of each tool rest table. Flanges accommodate either steel-backed silicon wheels or diamond wheels 6 in. in diameter and 1 in. wide with a ¾ in. rim. Standard wheels are 60 grit for roughing and 120 grit for finishing. A water pan and wick for moistening the diamond wheel is available as extra equipment. A pedestal can be provided for floor mounting of this grinder.



Hannifin Molding Press Pneumatically Operated

A 50-ton capacity plastic molding press developed by the Hannifin Mfg. Co., 621 S. Kolmar Ave., Chicago, Ill., is air-operated, requiring about 80 lb. per sq. in. air pressure to develop 50 tons. Higher air pressures can be used to increase this capacity to 70 tons. Over-all height is approximately 7 ft., and distance from floor to lower platen, when open, is 46 in. The press occupies less than 5 sq.ft. of floor



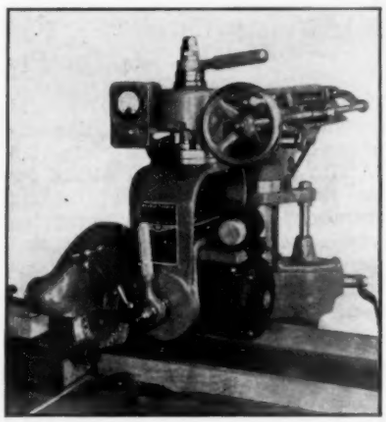
space. To accommodate various size dies, the strain head is adjustable for 12 in., permitting a maximum daylight space of 29½ in. Platen stroke is 8 in. Distance between columns is 22 in. Provision is made for the application of ejector pins or a separate ejector cylinder.

Pressure is developed through a combination lever and toggle mechanism developed especially for compression molding of thermosetting plastics. The platen advances rapidly, but decelerates when the dies begin to close, allowing time for the compound to soften. Smoother and denser products are said to be the result. The rate of up-travel and the return speed are both adjustable to suit the application. Full tonnage is applied to break the mold when reversing the cylinder. If air is not available, this press can be furnished with a self-contained hydraulic power unit.

Shock Absorbing Motor Used on Walker-Turner Saw

A universal radial saw made by Walker-Turner Co., Plainfield, N. J., may be used on a wide variety of shop work, both wood and metal. It has been found especially useful on pipe and tubing. Either steel saws or abrasive disks may be used for cutting.

The saw head is pivotally mounted



on a horizontal ram which slides on ball bearings in a saddle supported on a vertical column. This design makes it possible to set the blade at any angle desired.

The blade is mounted directly on the shaft of a geared motor, so designed that maximum clearance is obtained. Thus for a given depth of cut, a blade of minimum diameter may be used which, together with the mechanical advantage of the gear ratio, steps up the force delivered at the rim. Motors are available in four sizes: 1, 1½, 2 and 3 hp.

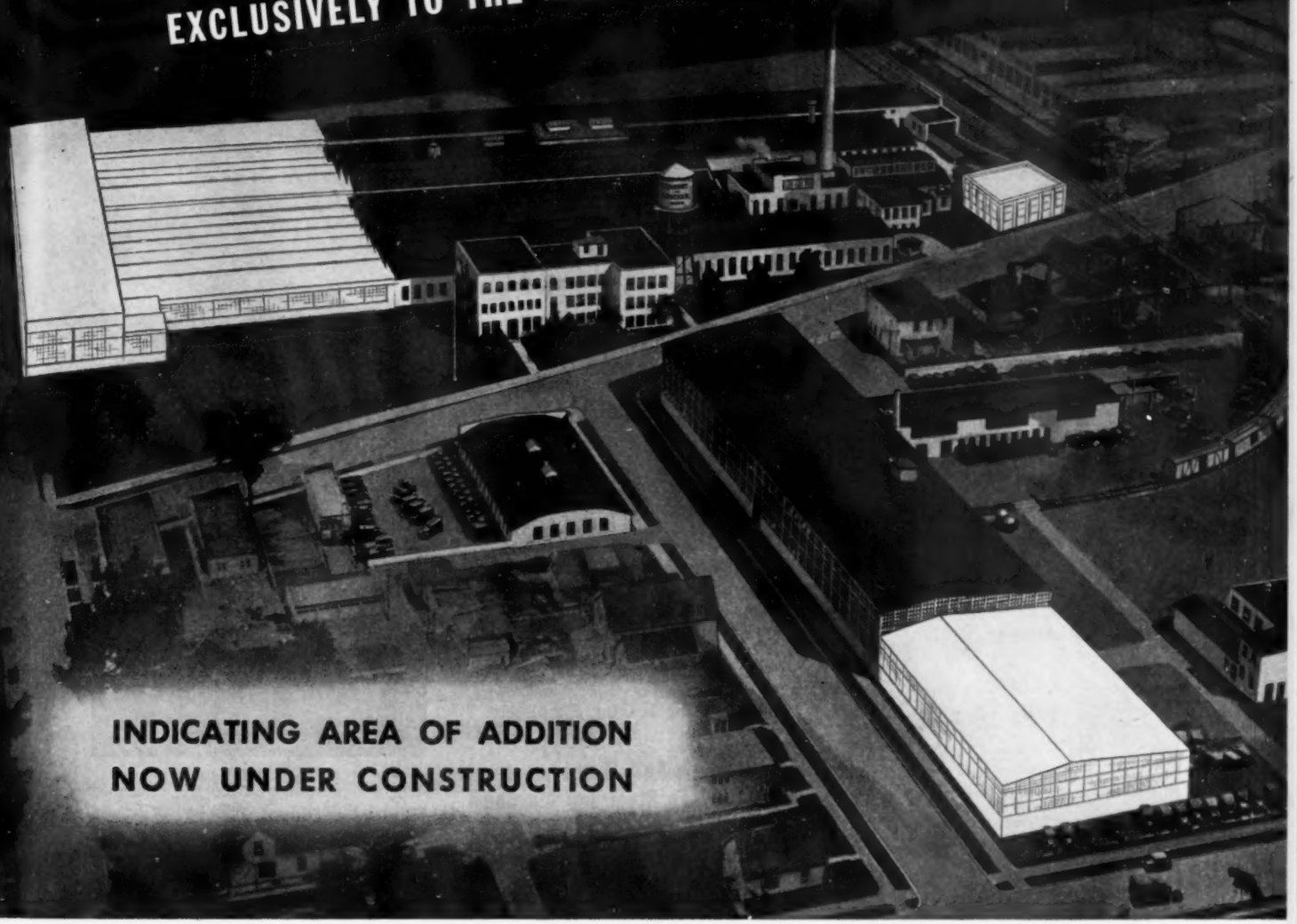
Gears are protected by a shock-absorbing device which consists of a conical mounting for the driving gear and a spring washer to hold it during normal loads. With this arrangement the saw may be suddenly stalled without damaging gears or motor. A magnetic overload circuit breaker gives added protection.

"Thor" Portable Nibbler Cuts Own Clearance

The small, portable "Thor" electric nibbler introduced by Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill., is only 9 in. long and weighs 3¾ lb. It is fitted with a yoke-type front head having a punch and die that nibbles out a rectangular shaving of metal at each upward stroke of the punch. The tool will cut up to No. 18 gage (0.049 in.) in steel and up to No. 15 gage (0.072 in.) in aluminum. Because it cuts its own clearance, this tool will cut wide strips without distorting or curling the sheet, even if the sheet is

Now Nearing Completion--

THE LARGEST PLANT IN THE WORLD . . . DEVOTED EXCLUSIVELY TO THE MANUFACTURE OF MILLING MACHINES



INDICATING AREA OF ADDITION NOW UNDER CONSTRUCTION

IN response to a continuing and unprecedented demand for Milwaukee Milling Machines, the Kearney & Trecker plant is now being expanded with every modern facility to enable us to increase our production and maintain the standards which have won world-wide recognition for the advanced design and construction of Milwaukee Milling Machines.

KEARNEY & TRECKER CORPORATION, Milwaukee, Wisconsin, U.S.A.

MORE THAN *41 years* OF DOING ONE THING WELL

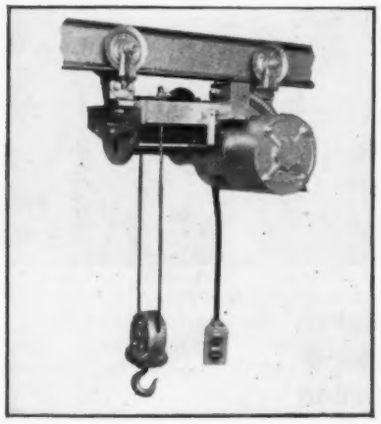
K&T

Milwaukee **MILLING MACHINES**

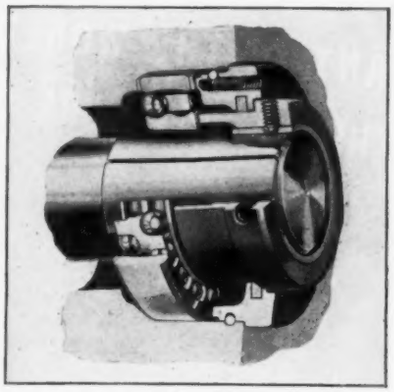
corrugated or has a curved outline. By drilling or punching a hole one inch in diameter and inserting the head of the tool in this hole, internal cuts of any shape may be made without breaking-in from the edge of the stock. Curves and circles with as small a radius as 1 in. can be cut, and shapes can be cut out of tubing that is as small as 1½ in. in diameter. The front head can be turned to either right or left and set at an angle of 30 or 90 deg. when space limitations make it desirable to cut at an angle to the motor housing.

Aluminum Reduces Weight In Electro Lift Hoist

A light-weight, high-speed cable type electric hoist in which all castings are made of aluminum alloy has been announced by Electro Lift, Inc., 30 Church St., New York, N. Y. The light weight makes this hoist suitable for applications requiring frequent moving and handling. It also is suitable for use in steam and acid fumes



because of the non-corrosive properties of the alloy. It is available in capacities from ⅛ to 3 tons and has all of the speeds and ratings of standard Electro Lift hoists. It may be equipped with a traveling rope guide to eliminate the hazard of crossed or piled up cables where loads are pulled at an angle from the vertical. This hoist has worm drive with worm and wheel running on Timken tapered roller bearings, fully inclosed within the gear case and running in a bath of oil. Control may be either rope or pushbutton. Top and bottom limit switches may be provided.



Ahlberg "Simplex" Bearings Made in Three Capacities

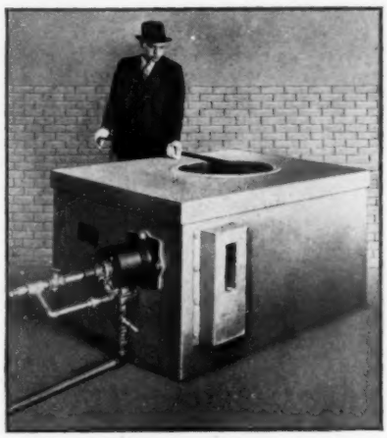
To provide machine manufacturers with a simple and economical means of incorporating ball bearings in their equipment where the bearing housing is an integral part of the machine, the Ahlberg Bearing Co., 3050 W. 47th St., Chicago, Ill., has developed a line of "CJB" Simplex units which are available in three capacities, for light, medium and heavy loads. They can be fitted with either single row, double row or self-aligning bearings. In the light series the bearings are mounted directly on the shaft, while the medium and heavy-duty units mount through a split adapter sleeve in a tapered bore bearing. Retaining caps are optional either in the open type, as shown, or the closed type, which seals the bearing completely.

Hewitt Bonds Soft Rubber To Steel and Aluminum

Hewitt Rubber Corp., Buffalo, N. Y., has developed a method for bonding soft rubber and Neoprene to steel and aluminum by hot vulcanization which results in high adhesion strength between the rubber and the metal with good aging qualities. By means of a chemical treatment the composition of the rubber is modified in such a manner that it will attach itself integrally to the metal and still retain its capacity to vulcanize itself to the outer rubber layer. Called the "Dura-Bond" process, it is said to result in an adhesion strength of 500 to 700 lb. per sq. in. The company limits its recommendations for the process to temperatures up to 200 F.

Holden Pot Furnaces Are Oil Or Gas Fired

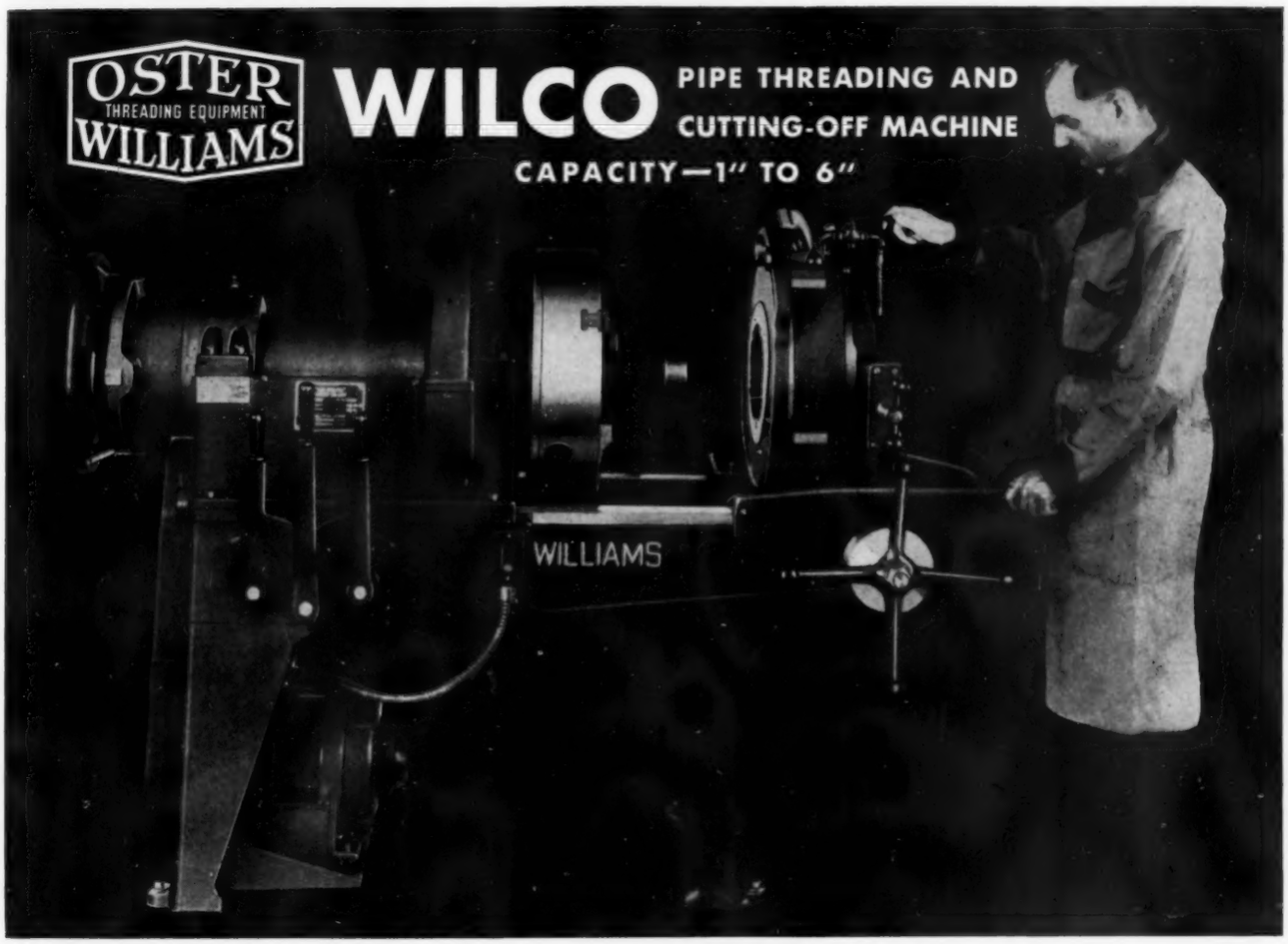
The A. F. Holden Co., New Haven, Conn., has developed an improved type of pot furnace claimed to secure approximately 30 per cent recuperation of fuel. This equipment can be built in either gas or oil fired units. Each of these furnaces has a specially constructed wall so that the exhaust gases pass at right angles to the incoming fuel. By this method of heating, the gas or oil is preheated



before it actually enters the chamber and the terminal velocity of gases passing out of the exhaust is only sufficient to support combustion. An additional feature of the design is the making of the pot a part of the top framework of the furnace, so that no seepage into the brickwork is possible around the top of the pot. These furnaces can be made in any size, multiple burners and exhausts being used in the larger sizes.

Improved Bijur Lubricators Are Operated Hydraulically

Automatic lubricators which have no mechanical drive connection between the machine and the lubricator pump have been announced by Bijur Lubricating Corp., 22-08 Forty-Third Ave., Long Island City, N. Y. In place of the driving mechanism, a small diameter tube is connected between the machine's hydraulic sys-



Preferred by Maintenance Men

Modern management rejects the old-style custom of using make-shift equipment and methods on maintenance work. Maintenance departments today are recognized as of basic importance to the efficient operation of manufacturing plants. For maintenance pipe-threading the national preference is the Wilco No. 706—a machine low in first cost but high in output, low in minutes-per-job but high in length of service. Read the two paragraphs at right . . . then send for complete descriptive bulletin.

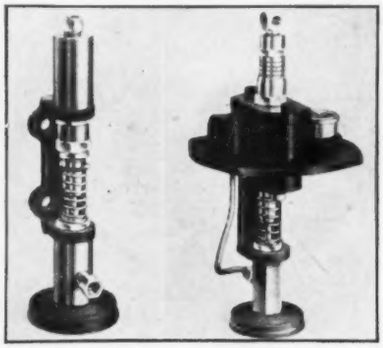
This single die-head takes care of all sizes of pipe within range of machine without change of dies except when change of pitch is required.

Small dies held in massive holders mean a decided economy in die costs for Wilco owners.

The OSTER MANUFACTURING COMPANY

Sales Offices: 2049 East 61st Street, Cleveland, Ohio
Factories: Erie, Penna., and Cleveland, Ohio
New York City Office, 30 Church St.
Threading Headquarters Since 1893

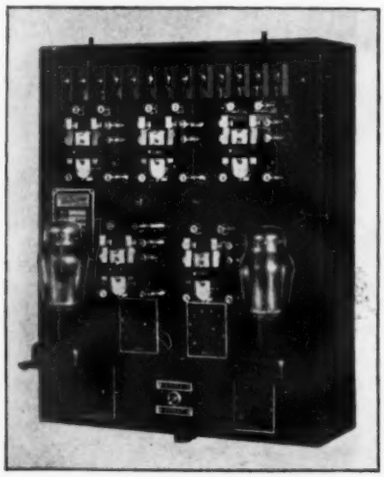
tem and the pump used for feeding oil to the various bearings. This has the advantage of giving maximum flexibility in design, as the pump can be located at the most convenient point, independent of any consideration as regards drive. These lubricator pumps are of two distinct forms: Type C is arranged for mounting on a standard two-pint or six-pint oil reservoir, while Type G is particularly adapted to mounting in a reservoir cast integral with the



machine. In the construction of these units, the lubricator pump is arranged so that the inlet is submerged under oil in the reservoir. This inlet is protected by a filter disk to prevent dirt or chips entering the pump or distributing system. A screw adjustment permits setting the working stroke of the pump to any predetermined length desired to meet lubrication needs of a particular machine.

Weltronic "Dual-Time" Unit Controls Two Welding Guns

Weltronic Corp., 2832 E. Grand Blvd., Detroit, Mich., offers the "Dual-Time" controller for accurately controlling two spot-welding guns at the same time through a single transformer. Of electronic tube type, this timer has two separate time control dials for adjusting the weld time for each gun. Each gun is provided with two control buttons and the operator can, after the timer has once been



set, make the proper time selection merely by pressing the proper button for the work to be welded. Thus, each gun may be used alternately as required for two different materials without further change. Listed as the Model 58-B timer, this unit has a frequency range of 1 to 30 cycles in even one-cycle steps for 110, 220 or 440 volt operations.

Welders' Ear Protectors Developed by M.S.A.

Developed to prevent injury to the ears caused by entry of flying sparks or hot metal particles, these welders' ear protectors announced by Mine Safety Appliances Co., Braddock, Thomas and Meade Sts., Pittsburgh, Pa., are made of close-woven, non-rusting screen with leather binding. The two protectors are held comfortably in place over the ears by an

adjustable spring steel headband. The protectors are deeply cupped, are ample in size to avoid cramping the ear, and permit complete ventilation and hearing. The headband is worn around the back of the head and does not interfere with wearing goggles, welding helmets or any head covering. The complete unit weighs 2 oz.

Ideal Coil Winder Drive Controlled by Foot Pedal

Equipped with a variable speed transmission and using a V-belt drive, the Model 210 coil winder drive announced by Ideal Commutator Dresser Co., 1057 Park Ave., Sycamore, Ill., provides an infinite number of driving speeds between 120 and 650 r.p.m. When the operator's foot is removed from the pedal the spring actuated brake automatically stops the machine. Besides the braking and running positions there is a neutral position secured through the foot pedal to allow for turning the machine by hand when required. A handwheel mounted on the shaft provides a means for hand turning coils when winding armatures and similar jobs. A conveniently located

revolution counter records by addition or subtraction the total number of turns. The unit is 48 in. high, 24 in. wide, and 18 in. deep. Height from floor to center line of shaft is 39½ in.

Victor Hacksaw Frames Have Pistol-Grip Handles

The Victor Saw Works, Inc., Middletown, N. Y., have added a line of four types of hacksaw frames to their line. These four frames vary in de-

sign and have molded pistol-grip handles. They take blades from 8 to 12 in. long and permit the blades to be faced in all four ways.

Crystal Lake Grinder Swings 2 1-2-in. Over Platen

The bench-type plain cylindrical grinder offered by Crystal Lake Machine Works, Crystal Lake, Ill., has a micrometer stop on the wheelhead to allow for grinding to size. This stop can be set to 0.0001 in. direct on dial. Spindle speed is 3,200 r.p.m. The machine will take a 6 in. diameter, 1/16 to ⅜ in. face wheel. Triple-geared table travels ½ in. for each turn of the hand wheel. Table platen swivels on center pin to 7 deg. either way for grinding tapers. Workhead has ½ in. collect capacity and can be fitted with a 2½ in. four-jaw inde-

WE'VE NEVER WORN IT AND WE NEVER WILL...

It's not difficult for men to lose the common touch when business rolls to a flattering tide. At such times the lofty attitude, the high hat is so easy to don.

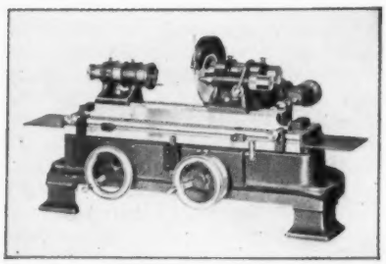
It is our earnest hope that throughout the far-flung LeBlond area of service, that LeBlond men and LeBlond customers will not forget that these are abnormal times and that the continuance of friendly understanding and respect is most to be desired.

Today -- while LeBlond is bending every facility to the service of American Industry -- who can know how far the present pace will extend?

It behooves us, therefore, to dismiss the temptation to indulge in self satisfaction, and seek rather to humbly deserve our present privilege of service . . . to be worthy in every way of our responsibilities.

THE R. K. LeBLOND MACHINE TOOL CO.
CINCINNATI, OHIO

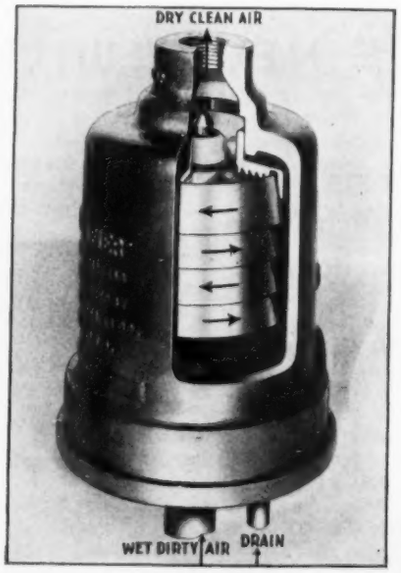
STEP DOWN COSTS *with a* LeBLOND STEP UP PROFITS



pendent chuck. Four changes of work speed are provided. The workhead will swing 2½ in. over the platen. Designed for belt drive, this machine can be furnished with an overhead jackshaft and motor mounting for bench use.

Logan Aridifiers Remove Moisture From Air Lines

The Logan Engineering Co., 4912 Lawrence Ave., Chicago, Ill., has made available a line of "Aridifiers" for removing moisture and oil from air and gas lines. These units are made in sizes from ⅜ to 10 in. They



are said to effectively remove dirt, scale, oil and moisture from compressed air lines and gas lines. This foreign matter impinges on a number of propeller blades revolving in opposite directions and propelled by the flow of air or gas. The arrested contamination is collected in the lower housing from where it is drawn off. These units are especially recommended for application to lines supplying compressed air to spray booths and other manual and automatic spraying and finishing operations.

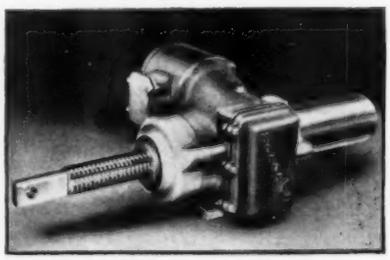
"Royal" Portable Light Is Sealed by Rubber

A rubber switch button completely envelopes the interior pushbuttons and cushions them against breakage in the "Sealed Tight" portable trouble light made by Royal Electric Co., 95 Grand Ave., Pawtucket, R. I. The socket is locked in rubber so

that oil, grease or dirt cannot reach the switch or electrical contacts. A strain relief disk presents pulling at the socket connections. The handle is made in one piece of specially compounded rubber and has no seams or side holes. The unit is claimed to be shock proof. Cushion mounting of the lamp guard increases lamp life by preventing jolts from reaching the lamp.

Electromarine "Motoram" Operates in Straight Line

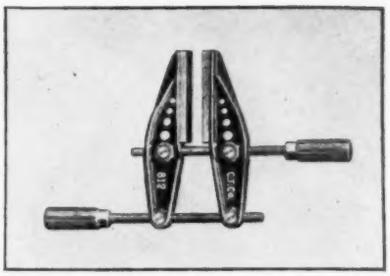
The "Motoram" mechanism developed by Electromarine Corp., Westport, Conn., produces a straight line power stroke in both directions. It is operated by an electric motor and is equipped with self-contained electrical and mechanical limit switches to stop movement of the shaft at any predetermined point of travel in either direction. Load is sustained on the shaft after the motor is stopped. Movable thrust shaft has minimum travel of ½ in. and maximum travel of 72 in. Movement may



be stopped automatically or reversed within 0.005 in. of travel. Four sizes are available with capacities of 100 to 3,000 lb. thrust.

Cincinnati Adjusting Clamp Has Wood-Faced Jaws

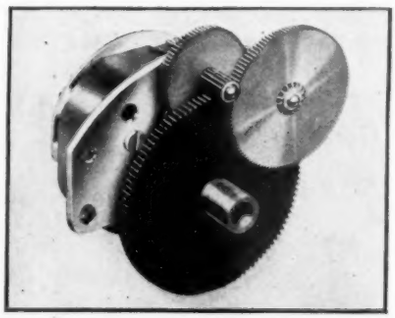
The No. 812 adjusting clamp offered by Cincinnati Tool Co., Norwood, Cincinnati, Ohio, has a 10¾ in. jaw length and 5½ x 2 in. wood-faced clamping surfaces. Maximum reach



from end of jaw to screw is 6 in. There are five sizes, with openings ranging from 4½ to 12½ in. Each clamp is tested to 4,000 lb.

Gear Reductions Offered For Barber-Colman Motors

A line of open-type gear reductions have been made available for size YAr motors by Barber-Colman Co., Rockford, Ill. Three standard gear ratios are available. These provide output shaft speeds of 80, 54 and 11 r.p.m. Several different outputs are provided for each speed, depending on the size and duty cycle of the motor employed. Cut spur gears are used in these reductions. A "Texto-



lite" gear is provided on the first step to reduce noise to a minimum. The steel gears are cadmium plated to resist corrosion. These geared head motors are designed for a maximum load of 50 lb. in. and three sizes of unidirectional motors are supplied with these gear reductions. Outputs vary from 0.0028 to 0.018 hp.

Haynes Stellite Announces Hard-Facing Welding Rod

The No. 93 hard-facing rod, an alloy welding rod for hard-surfacing wearing parts, announced by Haynes Stellite Co., unit of Union Carbide & Carbon Corp., Kokomo, Ind., is recommended for use where severe abrasion, accompanied by only a moderate amount of impact, is encountered. This rod does not possess as high wear resistance as "Haystellite" cast tungsten carbide products or "Stellite" alloys. It is, however, more wear-resistant but not as tough as "Hascrome" hard-facing alloy. This rod is of a ferrous composition and contains chromium,

molybdenum, cobalt and other alloying elements to the extent of more than 40 per cent. It has a tensile strength of about 43,000 lb. per sq. in., and a hardness, as deposited by oxyacetylene welding, of 62 Rockwell C. When deposits are heat-treated at 1,950 F. and then air-cooled, the hardness reaches 66 to 67 Rockwell C. Application of the rod is relatively simple. It is handled under the oxyacetylene flame with a slightly carburizing flame. When the rod is applied with the metallic arc process, reversed polarity is used, and flux-coated rods are recommended.

Hygrade Fluorescent Unit Made for General Use

The "Hygrade Miralume HF-200" complete fluorescent lighting unit made by Hygrade Sylvania Corp., Salem, Mass., is supplied complete with four 40-watt, 48-in. fluorescent lamps and with all wiring and fittings, ready to install. This lighting unit is corrected for power factor and stroboscopic effect is said to be practically eliminated. Over-all length is 48½ in., width is 10½ in. Units are available for 110-125 volts and 220-250 volts operation, and can be installed in any standard 60 cycle a.c. circuit. These units are designed for general use in offices and similar locations. A choice of daylight or white lamps is offered.

Castolin Welding Material Used at Low Temperatures

"Castolin" alloys and fluxes recently placed on the American market by Park Sales Co., 3 Park Place, New York, N. Y., can be used for oxyacetylene welding at low temperatures. Alloys suitable for welding steel, aluminum, brass and bronze are available. Castolin 190 for welding aluminum and its alloys flows at 930 F. and has a tensile strength of 35,000 lb. per sq. in. Castolin 185 is used for building up on steel, cast iron, copper, brass and bronze. It flows poreless at 750 F. Having a hardness of 230 Brinnell, it can be machined easily and is recommended for repairing broken or wornout machine parts. These and other Castolin alloys are described in pamphlet No. C-22.

New Lincoln Electrode Welds Stainless Steel

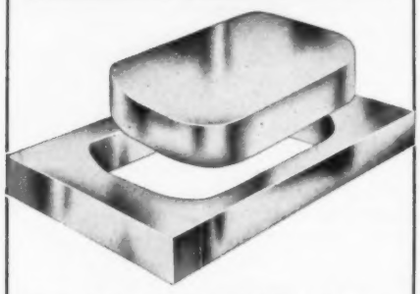
"Stainweld D" electrodes, announced by the Lincoln Electric Co., 12818 Coit Rd., Cleveland, Ohio, are recommended for arc welding stainless steel of the 25 per cent chromium, 20 per cent nickel type. It also is used for welding various stainless steels to mild steel, and for welding steels which are air hardening and cannot be heat-treated after welding. In general, preparation of the work and welding procedure is similar to that used in mild steel welding. For best results, only enough current should be used to obtain a free-flowing arc and proper fusion to base metal. This electrode is available in diameters from 3/32 to ¼ in. and is 11½ in. long.

Plated Aluminum Sheets Made by American Nickeloid

Combining the durability of nickel and chromium with the lightness, strength and workability of aluminum, Nickel Aluminum and Chrome Aluminum plated metals have been introduced by American Nickeloid Co., Peru, Ill. These two metals are formed by a surface of chromium or nickel bonded by an electrolytic process to an aluminum base metal, using the "Krome Alume" process patent. As the aluminum does not have to be etched to secure a bond, the luster of the plated surface is not dulled. These two pre-finished metals are available in sheets up to 36 x 96 in., in a full range of tempers, and in gages from 0.010 to 0.064 in. A choice of bright or satin finish and striped, crimped, or corrugated patterns adapt these metals to many

Send for this—
it will help solve your
drilling problems!
SUPER SERVICE UPRIGHTS
THE CINCINNATI BICKFORD TOOL CO.
Oakley, Cincinnati, Ohio, U.S.A.
The new 24-page catalog of Super Service Upright Drilling Machines is ready for you. No obligation.
The efficiency of the upright drilling machines in your shop may determine your chance for worthwhile profit in 1940. Now is the time to investigate these most modern machines. Write for Booklet U-25.
THE CINCINNATI BICKFORD TOOL CO.
OAKLEY · CINCINNATI · OHIO · U. S. A.

SAVED $43
MAKING THIS PUNCH



Capitol Products Co. of Winsted, Conn. made this punch for base of electric toaster from 2" thick Paragon Tool Steel. The DoAll produced it in 2 hours and 20 minutes. Accuracy from outside to bottom, within .003". They estimate these savings:

17 hours, 40 minutes $28.00
25 pounds of steel 15.00

STARTLING RESULTS

Contour Sawing, the new DoAll process of machining is recognized as the fastest precision method of removing metal; cuts out internal and external shapes from any metal up to 10" thick.

Does work of 3 machines. DoAll is a moderately priced, rugged precision machine tool that replaces shaping, milling and lathe work on a large variety of jobs with enormous savings.

Used in large and small plants in 30 countries by such firms as Cadillac, Fisher Body, Baldwin Locomotive, Federal Cartridge, New Monarch Machine, L. S. Hafkins, Edison Industries, Wayne Pump, U.S.Navy, etc.

Let a factory trained man bring a Do-All to your plant and show you what it does, what it saves on your own work.

FREE —
New Handbook on Contour Machining—158 pages of valuable metal working helps.

CONTINENTAL MACHINES, INC.
1310 S. Washington Ave.
Minneapolis, Minn.

☐ Send data on the DoAll AM-2
☐ Send Free Handbook

Name.....

Address.....

uses and designs, whether purely decorative or requiring a combination of the functional qualities of chromium or nickel. It is reported that both metals are easily workable during the manufacturing process and are highly resistant to corrosion, rust or tarnish. They can be bent, stamped or moderately drawn without damage to the permanently bonded coatings that are guaranteed not to lift or peel from the base metal.

G.E. Thermocouple Provides Accurate Furnace Control

General Electric Co., Schenectady, N. Y., has announced development of a radiation-type vacuum thermocouple for use wherever high sensitivity and rapid response are needed. This thermocouple is designed especially for controlled protective-atmosphere furnaces for processing materials at high temperatures. Inclosed in a vacuum, the thermocouple consists of a very thin filament of two different metals, blackened on one side. Radiant energy acting upon the thermocouple produces an electromotive force which is transmitted to a millivoltmeter or potentiometer which can be calibrated in degrees. The device may be mounted either temporarily or permanently upon a furnace, the only accessory needed being a closed-end tube in the furnace to prevent fogging of the lens and to form a target upon which to sight the thermocouple. Since the thermocouple has no physical contact with high-temperature furnace parts it will not be damaged by high temperatures. Temperatures higher than 1,500 C. can be handled by the addition of protective screens or filters between the thermocouple and the heat source.

Strips in M.S.A. Insoles Protect Feet Against Nails

Protection for the feet against nails, spikes, sharp metal projections and other dangerous underfoot hazards is provided by the "Safety Insole" offered by Mine Safety Appliances Co., Thomas, Braddock and Meade Sts., Pittsburgh. Built of two layers of overlapping steel strips molded in rubberized fabric, the safety insole is light and flexible, bending freely with every movement of the foot. Full details are given in Bulletin No. CK-1.

Enthone "Pickleen" Agent Speeds Pickling Operations

"Pickleen" agent for pickling baths announced by The Enthone Co., 442 Elm St., New Haven, Conn., is said to effect a marked lowering in the surface tension of sulfuric or hydrochloric acid pickling solutions which results in saving of acid by drag-out. It is claimed that the acid pickle containing the additional agent functions also as a cleaner, thus enabling smoother and more rapid pickling action on iron or steel which has not been thoroughly cleaned of all grease or oil. It is recommended especially for pickling parts in bulk for barrel plating, hot tinning, or galvanizing. This agent is stable in hot sulfuric acid solutions up to 15 per cent concentration. Bulletin No. 23 discusses other properties of this pickling bath agent.

TRADE PUBLICATIONS

BENDING ROLLS Buffalo Forge Co., 448 Broadway, Buffalo, N. Y., illustrates an extensive line of bending rolls and includes data and recommendations concerning their use, in a 24-page illustrated bulletin, No. 352.

BLOWERS Applications, design features and characteristics of several types of centrifugal blowers are provided in Bulletin No. 120-B-11, issued by Roots-Connersville Blower Corp., Connersville, Ind.

CIRCUIT BREAKERS Type AL-2 air circuit breakers for industrials and power stations are discussed in a 12-page illustrated bulletin, No. GEA-1662C, issued by General Electric Co., Schenectady, N. Y.

COMPRESSORS Catalog No. 502-J, issued by Ingersoll Rand, 11 Broadway, New York, N. Y., contains 36 pages providing specifications of Type 30 industrial compressors and vacuum pumps.

DRILLING MACHINES Bulletin No. 2989 D, issued by Buffalo Forge Co., 448 Broadway, Buffalo, N. Y., contains eight pages describing and illustrating the No. 22 drill.

ELECTRIC HAMMER Construction features, recommendations as to use, maintenance hints and other useful information concerning the operation of portable electric hammers are contained in a 24-page illustrated booklet, "The Van Dorn Portable Electric Hammer Handbook" available from the Van Dorn Electric Tool Co., Towson, Md.

FELT A Combined felt chart and sample file, available from Booth Felt Co., 434 19th St., Brooklyn, N. Y., lists a wide variety of applications for each type of each felt sample contained.

GEARS Illinois Gear & Machine Co., 2108 N. Natchez Ave., Chicago, Ill., lists detailed specifications of an extensive line of gears in its 64-page illustrated Catalog No. 39.

GRINDER—Cincinnati Grinders, Inc., Cincinnati, Ohio, is offering a 12-page bulletin, No. G-448, which de-

scribes the features and capacities of the recently announced 12-in. hydraulic Model ER universal grinding machine. Specifications for the four standard sizes are tabulated.

GRINDING Extensive data concerning many types of grinding wheels, including their dimensions, characteristics and recommendations as to their proper use, are provided in a 28-page illustrated bulletin, Form No. 1052-1P, published by The Norton Co., Worcester, Mass.

LATHES Design features and data concerning the Models No. 8, 10 and 12 automatic stub lathes are provided in a 12-page illustrated bulletin, Form No. 391, offered by Sundstrand Machine Tool Co., 2540 Eleventh St., Rockford, Ill.

MATERIALS HANDLING Junior Catalog No. 639, published by Barrett-Cravens Co., 3255 W. 30th St., Chicago, Ill., contains 172 pages describing 176 materials handling devices, including a line of lift trucks, portable elevators and electric hoists.

MOTOR BASE Specifications of pivoted motor bases and recommendations as to their use are provided in a sixteen-page illustrated bulletin, No. 861, issued by Rockwood Mfg. Co., 1801 English Ave., Indianapolis, Ind.

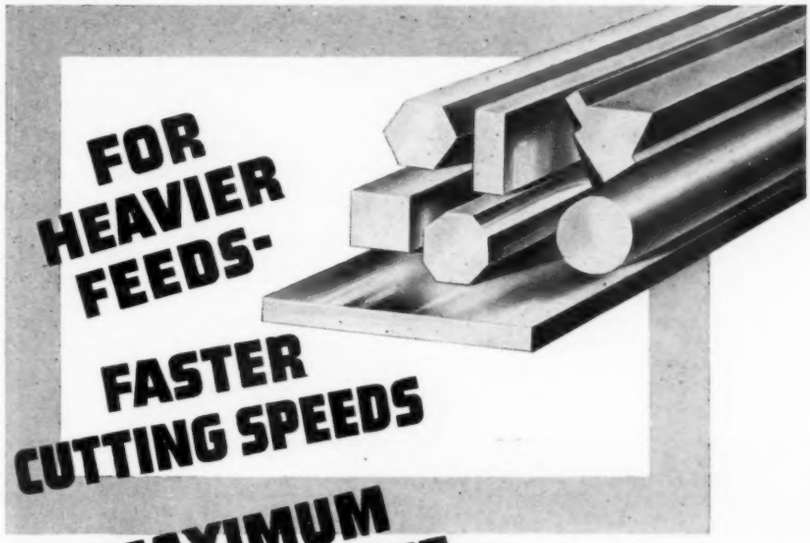
PRESSES Descriptions, features and specifications of an extensive line of hydraulic presses are provided in a 24-page illustrated catalog published by A. B. Farquhar Co., Ltd., York, Pa.

RELAYS Specifications and characteristics of percentage differential relays for transformer protection are provided in a 20-page bulletin, No. GEA-3236, issued by General Electric Co., Schenectady, N. Y.

"RIGIDMIL" Sundstrand Machine Tool Co., 2540 Eleventh St., Rockford, Ill., has issued two bulletins containing data and design information concerning several types of "Rigidmils." Form No. 382 discusses the Model No. 0, available with either hand or hydraulic feed, while Form No. 383 deals with the Model No. 1 hydraulic feed unit.

SAFETY Publication No. 299, released by the National Society for the Prevention of Blindness, Inc., 50 W. 50th St., New York, N. Y., contains 24 pages comprising a symposium on vision and eye protecton. Copies may be obtained from the society for fifteen cents each.

SANDERS Porter-Cable Machine Co., 1714 N. Salina St., Syracuse, N. Y., has issued a series of leaflets describing various types of sanders and grinders. Identified as Nos. 152, 153M, 159M, 168M, 169 and 171, they



insist on-

WYCKOFF LEADED STEEL

Join the numerous economy-wise operators of automatic screw machines who are cashing in on the extra-ordinary advantages of Wyckoff Leaded Steels.

Through the addition of a fraction of one per cent of lead in standard SAE analyses of Open Hearth and Bessemer steels, Wyckoff metallurgists have increased the usual machinability of SAE steels 25 to 65 per cent without impairing the original physical properties!

Think what this means to you in terms of your 1940 parts-production schedule! A single trial in your automatics will convince you of the unusual merit of Wyckoff Leaded Steels.

WYCKOFF DRAWN STEEL COMPANY

FIRST NATIONAL BANK BUILDING, PITTSBURGH, PENNA. — 3200 SO. KEDZIE AVENUE, CHICAGO, ILL.

Mills at Ambridge, Pa. and Chicago, Ill. . . . Warehouse Stocks in Principal Cities
Manufacturers of Carbon and Alloy Steels . . . Leaded Steels . . . Turned and Polished Shafting . . . Turned and Ground Shafting . . . Wide Flats up to 12" x 2"

deal with the Type B-3 belt sander and grinder, Type D-1 15-in. disk sander and grinder, Type S-1 oscillating spindle sander, Type B-6 irregular belt sander, Type O-4 oscillating spindle bench sander, and Type B-9 belt sander and grinder, respectively.

SAW Catalog No. 60, a four-page folder issued by Racine Tool & Machine Co., 1751 State St., Racine, Wis., describes the "Oil-Cut" hydraulic power-driven hacksaw.

SCREWS Applications, details and specifications of "Unbrako" socket head and self-locking screws are included in a 20-page illustrated bulletin offered by Standard Pressed Steel Co., Box 4, Jenkintown, Pa.

SHEAR Catalog No. F2, published by Cincinnati Shaper Co., Cincinnati, Ohio, lists the company's complete line of shears and describes many of the design details and construction features of these machines.

SPEED CHANGER Bulletin No. B6013, issued by Allis-Chalmers Mfg. Co., Milwaukee, Wis., contains 20 pages discussing the "Vari-Pitch" speed changers. Data concerning dimensions, power and speed are included.

STAGES Description and specifications of aluminum all-purpose stages are contained in a folder offered by Aluminum Ladder Co., Tarentum, Pa.

TURRET LATHES A twelve-page illustrated bulletin, No. 5 & 7 5M, issued by Bardons & Oliver, Inc., 1133 W. 9th St., Cleveland, Ohio, describes features of the Nos. 5 and 7 universal turret lathes available with single lever spindle speed preselector or with conventional three lever speed change.

WELDING Thyratron-controlled automatic arc-welding equipment is discussed in a 16-page illustrated bulletin, No. GEA-3042A, released by the General Electric Co., Schenectady, N. Y.

You too can have this Valuable Data . . . FREE

Guide to Treatment Shipped with Steel

Thousands of steel buyers are now enjoying the time and money saving features of the Ryerson Certified Alloy Steel Plan. They get carefully selected alloys which have all hardening factors (analysis, grain size, etc.) within a very narrow range. With every shipment, large or small, Ryerson sends accurate data on heat treatment response, and chemical and physical properties. There is no need to test, or experiment in order to secure desired results. You too can have this valuable data. It is given without additional cost or obligation. Simply specify Ryerson Certified Alloy Steels on your next requisition. Immediate Shipment will be made from large and complete stocks of these accurately identified, known quality steels. Ryerson Certified Steels also include carbon, tool and stainless steels. Write for the Ryerson Stock List, which gives data on all Ryerson Certified Steels.

Joseph T. Ryerson & Son, Inc., Chicago, Milwaukee, Philadelphia, St. Louis, Cincinnati, Detroit, Cleveland, Boston, Buffalo, Jersey City.

RYERSON CERTIFIED STEELS

RYERSON

NEW BOOKS

PRINCIPLES OF INDUSTRIAL ORGANIZATION, FIFTH EDITION—*By Dexter F. Kimball, dean emeritus of the College of Engineering, Cornell University, and Dexter F. Kimball, Jr., assistant production manager, Agfa Amsco Corp. 478 pages. Published by the McGraw-Hill Book Co., 330 West 42nd St., New York City.* $4.00.

While following the general arrangement that has been found so successful in classroom work, Dean Kimball's classic work on industrial organization has been brought up to date through the collaboration of his son, listed for the first time as co-author. Those of us who have had the pleasure of working as students under Dean Kimball know fully the broad approach to an understanding of our industrial set-up which this volume gives.

The description of the industrial revolution, the development of inventions and their economic effects, the growth of vast enterprises with their systems of industrial ownership, give the students and others interested in the subject a point of view that will always stand them in good stead. The later chapters, describing the methods used in modern plants, put the subject on a practical working basis. The volume has served well in the past and with timely revisions should continue to do so for many years to come.

•

INDUSTRIAL HEALTH—*By Dr. C. O. Sappington, former director of industrial health, National Safety Council, 275 pages. Published by Industrial Commentaries, 160 N. La Salle St., Chicago.* $3.75.

A great deal of well directed attention has been given industrial accidents. Not so much has been done about industrial health; but the subject is commanding increased in-

terest and for a good reason. Illness, not accidents, accounts for over 92 per cent of industrial absenteeism. The man-hour loss in the United States reaches the astronomical total of 280,000,000 yearly.

For the most part causes of ill health are non-industrial, but they have a direct influence on industry. An individual's value to a group depends largely on his health. Much can be done to promote right living which will aid him to keep well.

From a wealth of experience in this field, Dr. Sappington describes the work that can be done and how to do it. He points out that in the past, emphasis has been placed on medical and surgical services; that is, upon the patching up job rather than upon the vast task of prevention. He claims no formula for setting up an industrial health service, but he does describe certain fundamentals that may serve as a guide.

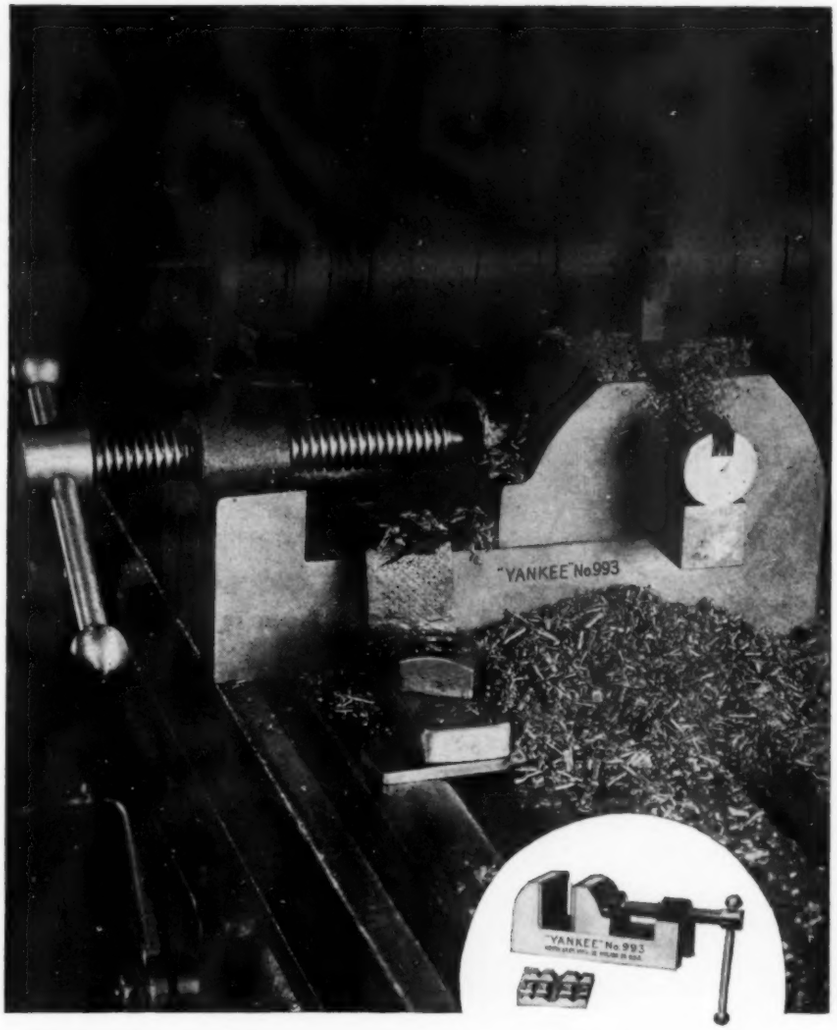
While the layman has taken considerable interest in the subject in recent years, Dr. Sappington believes the operation of any plan should be left to professionals — accredited doctors and nurses. He emphasizes that health service is not something that should be left to huge industries, as it is equally vital for small groups. As to the cost, he insists that the benefits far outweigh any expense that may be incurred.

The volume is concluded with a number of forms for physical examinations and for health surveys. They may provide a practical guide for those who have given a good deal of thought to the subject of industrial health and are ready to do something about it.

Copper-Base Alloys Tested for Die-Casting

At the recent National Metal Congress in Chicago (October 23-27), A. U. Seybolt and B. W. Gonser, metallurgists of the Battelle Memorial Institute, disclosed that on the basis of good physical properties and economy, combined with a low melting range, the best high-strength, die-casting, copper-base alloy of a large number studied by them contains 83 per cent copper, 5 per cent silicon, 10 per cent zinc, 1 per cent manganese, and 1 per cent aluminum.

It is stated that the strength and ductility of this Seybolt-Gonser alloy can be varied to suit specific needs by altering the proportions of manganese and aluminum. The latter makes the alloy remarkably resistant to oxidation at high temperatures. Although developed primarily for die-casting the alloy can be sand cast succesfully. This investigation of silicon brasses for die-casting was sponsored at Battelle by the Union Carbide and Carbon Research Laboratories, Inc.



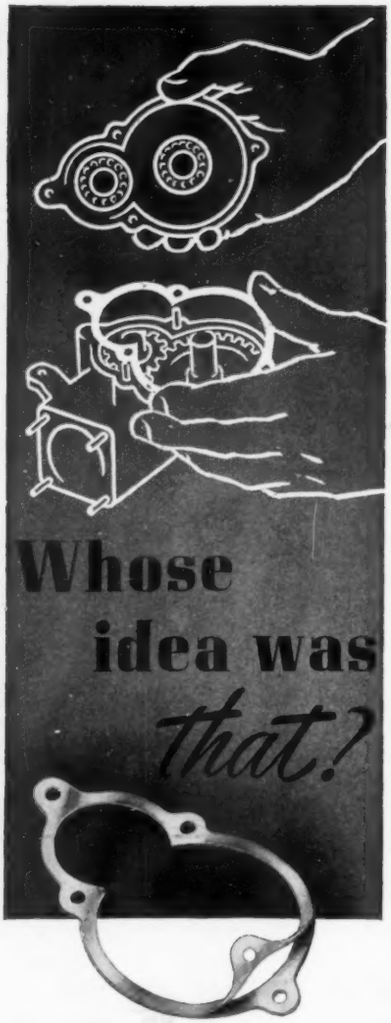
"YANKEE" VISE
SPEEDS PRODUCTION

"Yankee" is a *fast-production* vise—different from any other vise in your shop! Squared all sides. Designed for continuous work—from bench to machine and back again—accurate results and no delay. "Yankee" Vise illustrated above, made in four sizes: No. 991, 1½" jaw width. No. 992, 2" jaw width. No. 993, 2¾" jaw width. No. 994, 4" jaw width. Hardened steel block, V-grooved, supplied for holding rounds.

"Yankee" Vise also available with removable swivel base. Sizes, Nos. 1991, 1992, 1993 and 1994.

ORDER FROM YOUR SUPPLY HOUSE. FOR "YANKEE" VISE CIRCULAR, WRITE NORTH BROS. MFG. CO., DEPT. AM, PHILADELPHIA, U. S. A.

NORTH BROS. MFG. CO., PHILADELPHIA, U.S.A.



Leading aircraft builders now save many hours and dollars by *peeling* precision assembly adjustments...utilizing Laminum shims! • Throughout industry, assembly and service adjustments (for life of bearings) are made by simply peeling .002 or .003 inch laminations from "solid" brass Laminum shims. • *We supply Laminum shims cut to order. Sheet stock obtainable from mill supply houses.*

Laminated Shim Co., Inc.
21-14 44th Ave., L. I. City, N. Y.

FREE: File-folder of shim application photos — with Laminum sample.

LAMINUM
THE SOLID SHIM THAT peels FOR ADJUSTMENT

SEEN and HEARD

JOHN R. GODFREY

Plastic Chips Stick

Polishing the flutes of a twist drill may seem like a waste of time to those who have never had much to do with plastics. But now that we are using many types of compounds from Bakelite to soy beans, the polished flute becomes important. Polished surfaces help the chips to flow and tend to prevent clogging. Some even plate the flutes with chromium for this reason alone. With a 60 deg. cutting point, a longer lead helix and an air jet to help in cooling, plastic chips will flow fairly well without overheating the drill.

Fashions in Pulleys

Fifty years ago, when belting was almost the only means of power transmission, there were various theories as to what made a belt effective. Based on the theory that air trapped between belt and pulley induced slippage, belts were made with perforations to let the air escape. Others tackled the problem by drilling the pulley rim full of holes to permit the belt to force the air through to the inside.

Directly opposing this was the theory of air pressure against the belt holding it in contact with 14.7 lb. pressure per sq. in. over the arc of contact. Then there were the advocates of sticky belt dressings, those who lagged iron pulleys with paper and the use of resin when a belt started to slip.

A recent version of a pulley with depressions drilled or pressed into the rim to form vacuum cups. These are supposed to grip the belt and prevent slippage. It may be remembered that one auto tire manufacturer tried this on the tread but abandoned it. Sticky belt dressing probaby took as much power to pull away from the pulley as it saved in slippage. Vacuum cups would seem open to the same objection; but fashions of all kinds seem to go in cycles.

The Small Shop

One of the mysteries of the machine shop business is how many poorly equipped shops continue to provide a living for even one or two men, year after year. Little shops in which not a single machine would be worth more than its junk value give work to one or more men beside the boss, and enable him to drive a car that is a lot better than most of his machine equipment.

Of course, there is only one answer —the skill of the boss and his men, plus an uncanny ingenuity in finding ways of doing work that many better equipped shops would turn away. I have in mind one particular shop of this kind that is the mainstay of machine users for miles around. The boss will tackle anything from a sewing machine to a big gas engine, with 20-in. cylinders. And he has been so successful that he has made a good living for well over 30 years. He'll never be rich, unless he strikes oil in his back yard; but he has more real security than some of the men with bigger shops, a heavy investment and a payroll to meet.

The Best Toolmaker

BY CHARLES WESLOW

Who's No. 1 in the tool and die making profession? As soon as a toolmaker becomes one of the foremost, we hear from another who disputes his claims.

I consider *American Machinist* as the foremost mechanical magazine in the world. Soon as you have read that statement, you may say I am wrong. Henry Ford is the name of a man who stands out as the foremost individual in the manufacture of automobiles. No one can dispute that. If you think of others in that line, you have to think merely of corporations.

But where and who is No. 1 toolmaker? By that I mean all branches of the trade, including die making. A toolroom foreman may have in his employ the "best" toolmaker he ever knew, but if that foreman gets fired or quits his job, the next foreman will soon find a better toolmaker, according to his way of thinking.

An apprentice is like dropping a pebble in the water—just a splash, and it is gone. But it leaves a lot of ripples curling on and on and on. And there is no way of telling where the end is going to be, as the ripples keep curling on and out toward the sea. The apprentice makes a splash at first, and he becomes more conspicuous the following years as his rippling knowledge keeps spreading out in a wide range, until finally he has gathered so much knowledge he is no longer recognized due to entering the vast sea of knowledge. Like the ripple that has reached the sea and hardly noticeable anymore, so is the toolmaker with all his knowledge.

The trend these days is to train boys to one particular branch of the trade, but it is not certain if all the branches will be divided up between all the boys. If not, then some one branch or another will suffer for the lack of experts. On the other hand, no jobbing shop can get along without the services of toolmakers who have had an all around experience.

The best tool room in the country may not have the foremost toolmaker employed in it. And how can a toolmaker become foremost if he is accustomed to working in jobbing shops, like me, where the equipment is not so hot.